

CHAPTER 9 - WILDLIFE AND FISHERIES

Figure 9.1. Pathway Recommendations for Wildlife and Fisheries.

Wildlife and Fisheries Vision

Environmental conditions in the Lake Tahoe Basin support healthy terrestrial and aquatic ecosystems and sustainable native animal populations and vegetation communities.

Proposed Desired Conditions

1. Biological Integrity of Terrestrial Ecosystems:

The functional, physical, chemical and biological integrity of the Lake Tahoe Basin's terrestrial ecosystem are maintained at or above a sustainable level.

2. Sustainability of Special Status Species:

Populations of, and environmental conditions and processes important to native threatened, endangered, rare, special interest or sensitive species are maintained at a sustainable level.

3. Biological Integrity of Aquatic Ecosystems:

The functional, physical, chemical and biological integrity of the Lake Tahoe Basin's aquatic ecosystem are maintained at or above a sustainable level.

Proposed Indicators

1. Biological Integrity of Terrestrial Ecosystems:

Proportion of Terrestrial Ecosystem component benchmarks (as measured with various index of biological integrity and other relevant indicators) met or exceeded within an evaluation period. (Type II)

2. Sustainability of Special Status Species:

Proportion of Special Status Species that meet or exceed benchmarks (as measured by Productivity, Abundance, or Presence/ Absence and attribute indicators) within an evaluation period. (Type II)

3. Biological Integrity of Aquatic Ecosystems:

Proportion of Aquatic Ecosystem component benchmarks (as measured with various indexes of biological integrity and other relevant indicators) met or exceeded within an evaluation period. (Type II)

Proposed Standards

1. Biological Integrity of Terrestrial Ecosystems:

All component benchmarks for terrestrial ecosystems are met or exceeded within an evaluation period.

Components Include:

- Montane Vegetation Zone
- Upper Montane Vegetation Zone
- Sub-alpine Vegetation Zone

2. Sustainability of Special Status Species:

At least 20% of the benchmarks for Special Status Species (SSS) are met or exceeded within the first evaluation period.

At least 40% of the benchmarks for SSS are met or exceeded by the second evaluation period.

At least 60% of the benchmarks for SSS are met or exceeded by the third evaluation period.

At least 80% of the benchmarks for SSS are met or exceeded by the fourth evaluation period.

3. Biological Integrity of Aquatic Ecosystems:

All benchmarks for aquatic ecosystem components are met or exceeded within an evaluation period.

Components Include:

- Streams
- Lake Tahoe
- Wetlands
- Small Lakes

9.0 Wildlife and Fisheries Overview

The native wildlife and fish community is a natural and integral component of the Lake Tahoe Basin. At least 300 terrestrial and aquatic vertebrates occur in the Lake Tahoe Basin as residents or regular visitors. This total represents at least 217 bird, 59 mammal, 5 amphibians, 28 fish, and 8 reptiles. The abundance, composition, and condition of today's wildlife and fish populations has been primarily influenced by past land use (timber harvest, grazing, recreation), non-native species introductions, native species removals (e.g., grizzly bear), fire suppression, climate and urbanization. These factors have affected native species in various ways including: increased competition for resources (food, water, cover, and space), increased direct and indirect disturbance, habitat alterations, and altered species interactions.

The continuation of native wildlife and fish communities is important to the Lake Tahoe Basin. Biological resources provide ecosystem services (e.g., pollination, seed dispersal, pest control), enhance recreational experience (e.g., fishing, wildlife viewing), and can serve as barometers of environmental condition. This summary provides an abstract of why an update of desired conditions, indicators and standards and indicators is appropriate and preliminarily proposes what changes could be made to improve our ability to better understand the condition of aquatic and terrestrial biological resources with respect to activities and responsibilities of Pathway 2007 agencies.

9.0.1 Public Input

Public sentiment primarily expressed a desire to perpetuate healthy environmental conditions and restore degraded habitats to support native fish and wildlife populations, including listed species such as the Lahontan cutthroat trout. The desired conditions proposed attempt to address multiple issues related to the health of aquatic and terrestrial ecosystems as well as special status species populations. The set of desired conditions establishes goals to maintain and restore the completeness of these systems such that all native organisms adapted to environmental conditions in the Lake Tahoe Basin will persist for current and future generations to appreciate. Language has been included that recognizes the interconnectedness and health of ecosystems in which biological resources and human populations depend on to survive.

9.0.2 Existing Desired Conditions, Standards and Indicators

Existing desired conditions found in Pathway 2007 agency planning and management documents primarily identify goals for restoration and maintenance of habitats for the existing composition (circa 1988) of wildlife and fish species. In general, these goals are focused on the condition of habitat and do not express a preference for the maintenance of environmental conditions for either game and non-game species populations or native and non-native species populations.

Existing standards and indicators for wildlife and fish resources fall into two categories: 1) habitats of significance and 2) special interest species. Wildlife habitat standards are limited to riparian habitat, while fish habitat standards address conditions for Lake Tahoe and streams. Standards for special interest species include: 1) Federally listed species such as Bald Eagle and Lahontan Cutthroat Trout, 2) sensitive species, such as Northern Goshawk, and 3) public interest species, such as mule deer. Existing indicators were developed to measure whether threshold standards for fish and wildlife were being met.

9.1 Wildlife and Fisheries Vision

Wildlife and Fisheries Vision

Environmental conditions in the Lake Tahoe Basin support healthy terrestrial and aquatic ecosystems and sustainable native animal populations and vegetation communities.

The intent of the vision statement for Wildlife and Fisheries is that:

- Native terrestrial and aquatic biological resources of ecosystems of the Lake Tahoe Basin are restored, protected and sustained for current and future generations of residents and visitors to appreciate.
- The landscape includes the full range and proportions of environmental conditions and habitats expected to occur in the Lake Tahoe Basin. This includes the perpetuation of the oligotrophic status of Lake Tahoe's aquatic ecosystems.
- The timing (and/or return interval), intensity, and extent of natural disturbance within the Lake Tahoe landscape is consistent with the natural range of variability that existed prior to euro-American settlement to the extent feasible. The following caveats would apply:
 - The natural range of variability of natural disturbance can be characterized from tree coring/tree stump studies. The accuracy of the natural disturbance record is not likely to extend beyond 400 years from current.
 - Future climatic conditions influenced by global warming trends may require a reevaluation of expected environmental conditions and adjustment to conservation objectives.
- The landscape is comprised of a diversity of plant and animal species that is consistent with the natural heritage of the Lake Tahoe Basin; That is, habitats are comprised of species that evolved in and are adapted to natural environmental conditions in the Lake Tahoe Basin.
- The vision recognizes that there is stakeholder interest to perpetuate a recreational sport fishery at Lake Tahoe. These recreational resources along with other wildlife and fish resources are managed by the States of California and Nevada in cooperation with the U.S. Fish and Wildlife Service. The proposed vision or desired condition statements are not intended to supersede the management or statutory authority of the State of Nevada or California, or United States Fish and Wildlife Service.
- There is recognition that past land use, development, and species introductions have altered the condition of some locations such that the basin will not be fully capable of achieving this Vision in all areas of the basin. However, all efforts to restore altered or degraded habitats and interrupted ecosystem processes should be pursued where feasible. Additionally, although aquatic trophic dynamics and landscapes have been historically altered, this condition will not limit responsible agencies attempts to restore native species assemblages.
- "Sustainable" means to perpetuate healthy and functional ecosystems comprised of native flora and fauna for the appreciation of current and future generations of residents and visitors.

9.2 Need For Change

Desired Conditions

- Overall, there is a need to unify desired condition statements amongst the Pathway 2007 agencies. A common vision for aquatic and terrestrial biological resources will result in streamlined relationships and implementation of projects and programs to accomplish agreed upon strategies.
- There is a need to modify desired condition language from a set of mostly habitat-centric goals to goals that address both biological and habitat conditions. That is, desired conditions need to identify the condition of native wildlife and fish populations as the end point of policy and management activity. In doing so, statutory requirements, such as the Clean Water Act, will be satisfied. Ultimately, wildlife and fisheries resources and overall environmental quality will benefit as well.

Indicators

- The statistical characteristics of existing indicators for wildlife and fish are not adequately understood or documented.
- Many indicators are based on subjective determinations (e.g., TRPA's stream condition evaluation criteria) and/or may be biased to a specific group of species (e.g., non-native trout, birds of prey).
- Existing indicators primarily measure surrogates of biological condition rather than direct measures of species to determine condition. Consequently, some indicators are of little value in assessing the true condition of habitat or species populations.
- Existing indicators are categorized either by agency or resource (threshold) area and evaluated independent of each other. Consequently, inherent ecological relationships can go undetected (e.g., soil, vegetation, wildlife) and monitoring efficiency is lost.
- Multiple resource (threshold) categories may measure related or even identical targets differently.
- For the aquatic environment, numeric chemical parameters have been primarily used as indicators of condition, which is not the most appropriate measure of biological status and trend. Biological integrity (health) is best measured as an integrated effect of chemical, physical and biological components parameters.

Standards

- Most of the existing "non-degradation" standards do not provide a reference condition to measure divergence from the desired state (e.g., riparian habitat).
- Assumptions that formed the basis of many of the original standards are now unsupported by new information (e.g., support a population of Peregrine Falcon). As a result, some standards are not achievable.
- Achievement of non-numeric standards is open for interpretation by whoever evaluates attainment, thus not reliably repeatable by different analysts.
- New regulations (such as National Forest Management Act, 2005) will require agencies to update environmental targets (e.g., USFS Special Interest Species).
- Some standards are poorly articulated or ambiguous and there is no standardized field or analysis protocol available for reference such that interpretation is left up to an evaluator.
- Traditionally for the aquatic environment, numeric chemical parameters have been employed as standards, and may not be the most appropriate since these datasets are usually scarce or interpolated to different species and/or habitat from that of the study area.

9.3 Desired Condition 1: Biological Integrity Of The Terrestrial Ecosystem

The terrestrial/upland ecosystem contains more than 15 different habitat types including examples of late seral/old growth forests. As result, a wide range of wildlife species depend on the health of the terrestrial ecosystem to provide food, cover, space, and water; which are factors critical to all wildlife and fish populations. Terrestrial ecosystems are also important for supporting populations of species of concern, such as the California Spotted Owl and Northern Goshawk. In the Lake Tahoe basin, terrestrial ecosystems are viewed by land use planners as most capable of absorbing/supporting residential and commercial development, and are often the focus of more intense resource management and the placement of recreational facilities. Thus, it is important to identify desired conditions that maintain the integrity of biological resources to the greatest extent feasible such that land use and management activities do not degrade the terrestrial ecosystem to a non-retrievable state.

Associated Attributes of Biological Integrity of the Terrestrial Ecosystem

Habitats that occur within the terrestrial ecosystem support native and non-native species, special habitat elements (e.g., snags and downed wood), and differing levels of human activity. These attributes and their respective importance are outlined in Table 9-1.

Table 9-1. Associated Attributes to Terrestrial Ecosystems and Attribute Indicators:

| Attribute Category | Importance |
|--|--|
| Native Species Persistence | Terrestrial/upland habitats support viable populations of the full complement of associated native plant, invertebrate and vertebrate terrestrial-dependent species. |
| Alien, Invasive and Domesticated Species | Alien and invasive species reduce native species diversity and habitat quality through competition for resources, predation, or parasitism. Domesticated animals (such as cats and dogs) have been known to chase, harass, injure, and/or kill native biota. |
| Plant and Animal Community Diversity | Structural diversity and native species composition of plant and animal communities provide habitat and critical ecological functions for native species. |
| Special Habitat Elements | Special habitat elements make a significant contribution to supporting one or many species relative to their abundance, such as large snags and logs, large trees with and without decadence, caves, and talus areas. |
| Special Community Types | Unique terrestrial community types (such as late seral forests and talus slopes) contribute to landscape and species diversity. |
| Landscape Configuration | The spatial and temporal amount and distribution of vegetation types and special habitat elements differentially supports wildlife populations and allows for unobstructed movement of terrestrial species to support viable wildlife populations. |
| Human Activity | Human activities or past and present management or land use actions can adversely impact the integrity of terrestrial ecosystems. |

9.3.1 Proposed Indicators of Biological Integrity of the Terrestrial Ecosystem

Proposed Key Indicator for Biological Integrity of Terrestrial Ecosystems
Proportion of Terrestrial Ecosystem component benchmarks (as measured with various index of biological integrity and other relevant indicators) met or exceeded within an evaluation period. (Type II)

The terrestrial/upland ecosystem can be stratified into 3 vegetation zones (i.e., terrestrial ecosystem components) to measure biological condition. Vegetation zones include:

- Montane Vegetation Zone – generally occurs at lower elevations and is primarily dominated by the Jeffery pine conifers with inclusions of other habitats including shrubs, meadow and aspen.
- Upper Montane Vegetation Zone – generally occurs at middle elevations and is primarily dominated by a mix of conifer trees including white fir and Jeffrey pine with inclusion of other habitats including shrubs, meadow, and aspen.
- Subalpine Vegetation Zone – generally at the highest elevations and is primarily dominated by red fir, white bark pine, hemlock, and western white pine with inclusions of rock and soil outcrops, shrubs, meadows and aspen.

Key Indicator – Biological Integrity of Terrestrial Ecosystems

The Key Indicator is measured by determining the proportion of terrestrial components that have met or exceeded benchmarks within an evaluation period. Benchmarks will be established that are above a sub-optimal condition (Figure 9-1). The key indicator value will provide an overall assessment of the biological condition of the terrestrial ecosystem for the Lake Tahoe Basin. For example, if 2 of the 3 terrestrial components are at or above their benchmark in an evaluation period, then the Key Indicator is about 66%; indicating that about 33% of the components are not in attainment. This approach will allow an evaluator to gain an understanding of the terrestrial ecosystem as a whole as well as alert the evaluator to which terrestrial component needs additional management and/or policy attention.

Diagnostic Indicators

For each vegetation zone, an index of biological integrity (IBI) is proposed to measure biological conditions. The IBI's will use the terrestrial (landbird) bird community to judge biological condition relative to human influences for each vegetation zone. As displayed in Figure 9-1, a range of conditions in each vegetation zone will be identified from sub-optimal (unhealthy) to sustainable (healthy) to optimal (biological integrity). Benchmarks based on a range of IBI values will demarcate where conditions move from sub-optimal to sustainable biological condition and from sustainable to optimal biological condition (See Figure 9-1). Benchmark achievement would be based on what proportion of sample units IBI scores are within one of the condition categories. For example, if 100 random samples are collected within the montane vegetation zone, reasonable and achievable benchmarks for the montane vegetation zone would be that no more than 15% ($n = 15$) of the sample unit IBI scores are in the sub-optimal condition and that at least 40% ($n = 40$) of the sample unit IBI scores are in the optimal condition class with the remaining proportion of sample unit scores occurring in the sustainable condition class. Assigning benchmarks in this way establishes a standard to maintain a high proportion of the terrestrial ecosystem in a healthy and intact state as well as establishes that maintenance of areas within a sub-optimal condition category as non-desirable.

Additional analysis is required to identify the technically appropriate position to set benchmarks (i.e., what IBI score indicates a degraded condition? and what proportion of the sample can occur in a sub-optimal state?) as well as consultation with decision-makers, technical working groups and the general public.

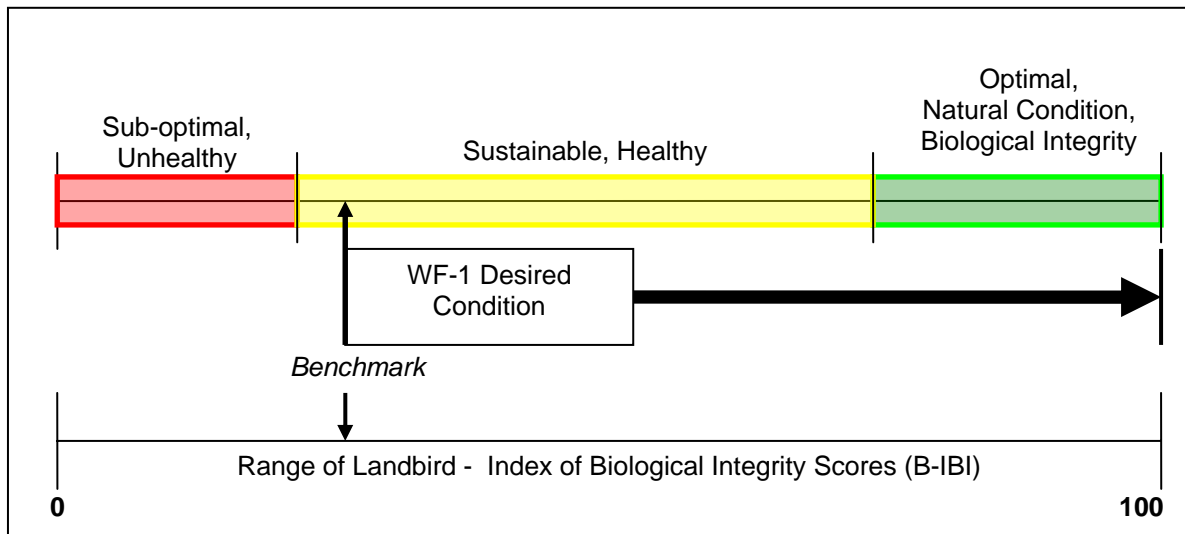


Figure 9-1. Terrestrial Ecosystem Diagnostic Indicator – Montane Vegetation Zone. A diagrammatic representation (adapted from the Karr and Chu, 1999) of the relationship of the diagnostic indicators to the desired condition as applied to a terrestrial ecosystem component (e.g., Montane Vegetation Zone). A benchmark based on the range of Landbird – Index of Biological Integrity (B-IBI) scores would demarcate where conditions are in attainment with the desire condition for that component. A Landbird-IBI score can be generated for each sample site.

9.3.2 Current Conditions and Trends Related to the Biological Integrity of the Terrestrial Ecosystem.

A recent synthesis of conditions in the Lake Tahoe Basin show that terrestrial ecosystems have undergone noteworthy changes over the past 150 years resulting from logging, grazing, development, and fire suppression (Manley et al. 2000). Perhaps the greatest impacts were from logging in the late 1800s, which resulted in a large proportion of the basin being logged and the loss of old forests, followed by lack of fire, which resulted in densely stocked even aged stands of white fir trees and high rates of mortality. Past sheep and cattle grazing likely changed the composition, structure and hydrologic function of meadow and many riparian areas, but this has not been well studied in the basin.

Presumably undeveloped sites with high biological integrity throughout the Lake Tahoe Basin would be ideal. Reference sites (areas with low or no development) were evaluated to help us understand the ecological potential of the basin, or the “best case scenario” without human development and use. Not all sites with no or low development have the optimal complement of native species because of a variety of factors, including natural variability in site conditions and capacities, site impact unrelated to development, and species-specific factors (e.g., disease, hunting). Based on some preliminary analysis, the proportion of the basin in each condition class (as described in the Technical Supplement) sites varied to some degree among the IBI scores, but generally

reflected that approximately 50% of the sites were in optimal condition, 40% of the sites were in sustainable condition, and 10% of the sites were in sub-optimal condition.

9.3.3 Technical Range of Feasibility for Biological Integrity of the Terrestrial Ecosystem

As discussed above, the key indicator for the Biological Integrity of the terrestrial Ecosystem is based on benchmarks for different terrestrial components. The Landbird – IBI diagnostic indicator represents a gradient of condition and is categorized into three level of condition from unsustainable to sustainable to optimal biological integrity (figure 9-1). A shift in the proportion of sites from unsustainable/suboptimal to sustainable or sustainable to optimal is feasible with the appropriate land use/management policy and restoration. However, the percentage of sites that could feasibly move from unsustainable to optimal is not likely, as many of these sites are degraded as a result of urban development.

Several attribute indicators will also contribute to the Biological Integrity of the Terrestrial Ecosystem benchmarks. The current conditions for many of these indicators are unknown at this time so assessing the feasibility of reaching a given condition is not possible at this time.

9.3.4 Proposed Desired Condition and Standards for the Biological Integrity of the Terrestrial Ecosystem.

Proposed Desired Condition for Biological Integrity of Terrestrial Ecosystems

The functional, physical, chemical and biological integrity of the Lake Tahoe Basin's terrestrial ecosystem are maintained at or above a sustainable level.

The intent of the desired condition statement is to direct those responsible for land stewardship and regulation in the basin to emphasize the importance of restoration and maintenance of intact and connected terrestrial habitats, as well as provide emphasis on the processes that create and maintain habitats in order to perpetuate native animal and plant communities for current and future generation to appreciate.

Biological Integrity means:

- The ability to support and maintain a balanced, integrated, and adaptive biological system having the full range of elements and processes expected for a region. Biological integrity is the product of ecological and evolutionary processes at a site in the relative absence of human influence (Karr and Chu, Restoring Life in Running Waters: Better Biological Monitoring, 1999).
- A balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of a natural habitat of the region (Karr and Dudley, 1981).

The standard for the Biological Integrity of the Terrestrial Ecosystem is that all component benchmarks are met or exceeded in an evaluation period. This standard is

feasible given that it is based on known landscape disturbance patterns and preliminary analysis of biological data. Currently, no more than 15% of the terrestrial/upland landscape is urbanized and preliminary Landbird – IBI analysis has demonstrated that we are meeting the proposed standard. The feasibility of individual attribute indicators remains unknown, benchmarks for attribute indicators will be established as field information is generated in the first evaluation period.

Proposed Standard for Biological Integrity of Terrestrial Ecosystems:

All component benchmarks for terrestrial ecosystems are met or exceeded within an evaluation period. Components Include:

- Montane Vegetation Zone
- Upper Montane Vegetation Zone
- Sub-alpine Vegetation Zone

9.4 Desired Condition 2: Sustainability Of Special Status Species

Desired conditions and associated standards identified for the Biological Integrity of Aquatic and Terrestrial Ecosystems should contribute to sustaining populations of common wildlife, fish, and plant populations in the Lake Tahoe Basin. Special Status Species (SSS) are individual species that are in need of focused study and management attention because of low population size and/or distribution (i.e., isolated population), changing trends in abundance, and other factors. Such species usually require specific management actions that are tailored on a species specific or site specific basis. The status of SSS has often been used to gauge environmental conditions of a region as well.

Associated Attributes of Special Status Species

Attributes associated with the desired condition include the range of biological and physical conditions needed for the perpetuation of special status species populations. Sufficient space is available and protected such that special status species can carry out their normal activities of food gathering, mating, and caring for young.

9.4.1 Proposed Indicator for Special Status Species

Proposed Indicator for Special Status Species

Proportion of Special Status Species that meet or exceed benchmarks (as measured by Productivity, Abundance, or Presence/Absence and attribute indicators) within an evaluation period. (Type II)

The following criteria were used in combination with input provided by the Fish and Wildlife Technical Working Group to screen species for considerations as “Pathway” Special Status Species (i.e., Federally Threatened and Endangered, species-of-concern, and species-of-interest, species):

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1. Threatened and Endangered Species – Species listed under the Endangered Species Act;
2. Species of Concern – Management actions may be necessary to prevent listing under the Endangered Species Act;
 - a. Species identified as Candidate and Proposed under ESA;
 - b. Species with ranks of G-1 through G-3 on the NatureServe ranking system;.
 - c. Intraspecific (subspecific) taxa with rank of T-1 through T-3 on the NatureServe ranking system;
 - d. Species that have been petitioned for Federal listing and for which a positive “90-day finding” has been made;
3. Species of Interest (and Focal Species) –
 - a. Species with ranks of S-1 and S-2 on the NatureServe ranking system;
 - b. State listed threatened and endangered species that are not within the criteria as species of concern;
 - c. Bird species on the US Fish and Wildlife Service Birds of Conservation Concern National Priority list;
 - d. Additional species that have valid, existing information indicating regional or local conservation concern due to factors that may include significant threats to population or habitat, declining trends in population or habitat, rarity, or restricted range;
 - e. Additional species that need plan components established for them. These should include species of public interest, including hunted, fished, and other species.

If this criterion were strictly applied, the list of species would become extremely long for species-of-interest. Consequently, the Wildlife and Fisheries Technical Working Group was used to identify only those species truly in need of additional management attention. The selection of species was an iterative process that will likely continue be debated by technical groups, decision-makers and the public. Additional discussions and iterations of the species list are recommended to further rectify a species list that is manageable given funding and other constraints. One approach to getting resolution to removing species from addition management consideration is to develop criteria, such as species is common in the basin, management and policy would have no effect on the species viability, sufficient suitable habitat is protected, etc.

Key Indicator to Measure Overall Special Status Species Condition

The Key Indicator is the level of attainment of each benchmark set for each listed Special Status Species (SSS) for an evaluation period. It is conceptualized that attainment will be met over varying periods of time based on the response of individual Special Status Species to management actions, policies, and naturally occurring environmental conditions (Figure 9-2).

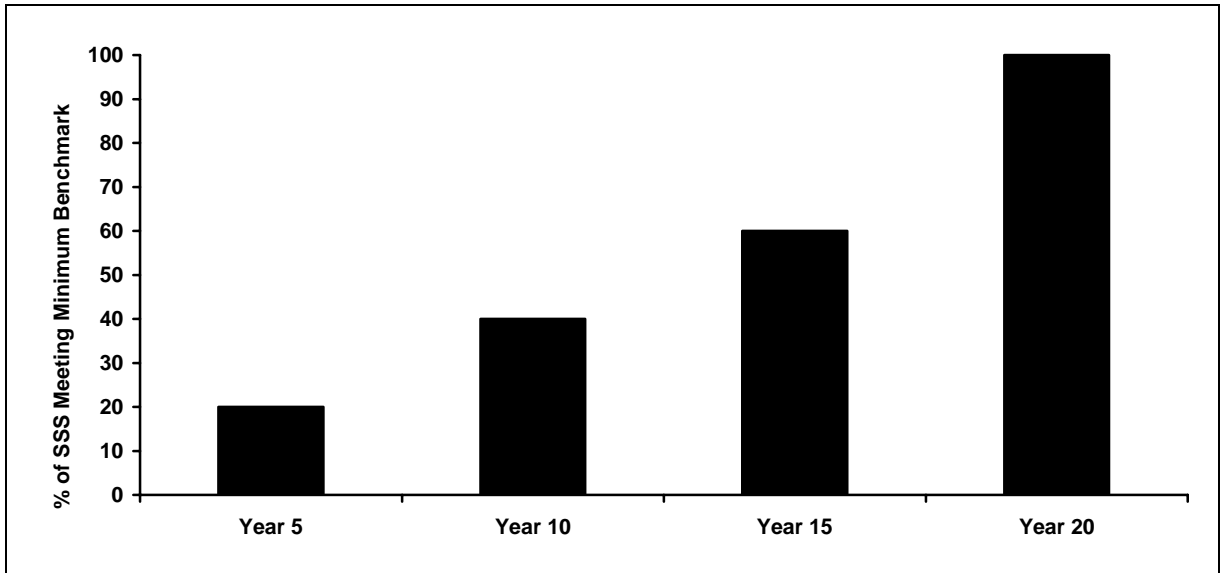


Figure 9-2. Hypothetical Indication - Special Status Species Attainment through Time. The Key Indicator is measured by determining the proportion of SSS that have reached or exceeded the individual species' benchmark. This value gives an overall assessment of the species in attainment at any point in time. For example, if 5 of the 17 Special Status Species are at or above their associated benchmark in measurement year 5 (the first evaluation period), then the Key Indicator is about 30%--indicating that about 70% of the species are not in attainment. If the standard is set for 20% in the first evaluation period, the above example would indicate that the Region would be in attainment with the standard.

Diagnostic Indicators

The diagnostic indicators selected to monitor attainment of the desired condition (and the standard) for SSS, and to quantify the response of SSS to change over time are special status species presence-absence, abundance, and productivity. Derived according to level of monitoring effort, these categories or levels are nested and not mutually exclusive. For example, information on abundance also quantifies presence-absence. The specificity of information needed for a special status species, going from least specific (presence-absence) to most specific (productivity), is based on the concern for the status of a species in the Lake Tahoe Basin. Species at very low abundance that are known to be sensitive to human disturbance, for example, should be assessed at the highest level (i.e.,: productivity). Conversely, for some species a quick assessment of presence-absence will provide the information needed to plan at least initial management actions.

Presence-absence

Measured for all special status species in all ecosystem types, this metric provides assessment of the use (presence) or non-use (absence) of a specific location within the Lake Tahoe Basin.

Abundance

Abundance is measured for a subset of species determined to be of higher priority for determining population direction (increasing or decreasing in numbers). The measure is obtained by conducting repeated measurements of a species throughout an area of interest to generate estimates of abundance (usually expressed as number of animals per unit area). Specific sampling methods are available for each special status species.

The resulting data provide a quantitative assessment of the number of animals present and thus serve as a basis for monitoring the trend (i.e., increasing, stable, decreasing) in numbers over time.

Productivity

Productivity is measured for a subset of species (for which abundance is measured) determined to be of highest priority for determining the causes of population changes.

Measures of productivity include:

- Observable Reproductive Success - Number of eggs, fledglings, or young per nest, den or pair in a given season. Also could include an enumeration of the number of females reproducing per season, proportion of areas (e.g., territories) where reproductive activities are observed (young, brooding, denning, etc).
- Population Structure – Measures of population growth and structure such as, age ratio, sex ratio, mortality rates, fecundity rates, and growth rates.

9.4.2 Current Condition and Trend for Special Status Species

The current condition for Special Status Species depends on the species in question. The 2001 TRPA Threshold Evaluation indicated that overall, the region was not in attainment with the standard set for TRPA listed Special Interest Species. However, the determination that TRPA listed species were not in attainment with the threshold standard does not necessarily indicate that SSS are doing poorly in the basin. As stated in the need for change section above, standards need to be updated to reflect new information. In general, it can be stated that SSS populations that are currently monitored are stable or increasing. Figure 9-3 presents activity trends for three Special Status Species.

9.4.3 Technical Range of Feasibility for Special Status Species

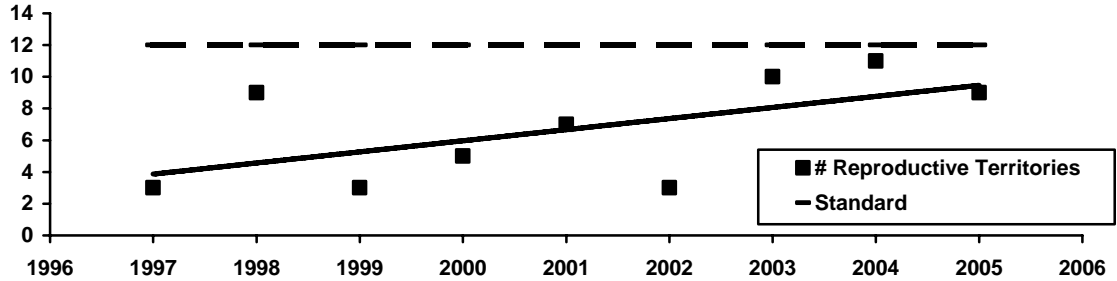
Changes in abundance, presence-absence, or reproductive activity are driven by a host of interacting factors, primarily including reproductive success, recruitment of animals into the breeding population, and adult survival. Animals breeding within the Lake Tahoe Basin could come from local production or from immigration from locations outside the basin. As such, diagnostic indicators proposed to monitor animal distribution (presence-absence), abundance, and reproductive activity provides a general and overall understanding of animal population's status. A decline in abundance and distribution accompanied by reproductive values that are low relative to published data for stable populations are intended to trigger more intensive study.

The Key Indicator is measured by determining the proportion of SSS that have reached or exceeded the individual species' benchmark (which are based on individual species and associated diagnostic indicator). This value gives an overall assessment of the SSS benchmark attainment at any point in time. For example, if 5 of the 17 Special Status Species are at or above their associated benchmark in measurement year 5 (the first evaluation period), then the Key Indicator is about 30%--indicating that about 70% of the species are not in attainment. If the standard is set for 20% in the first evaluation period, the above example would indicate that the Region would be in attainment with the standard.

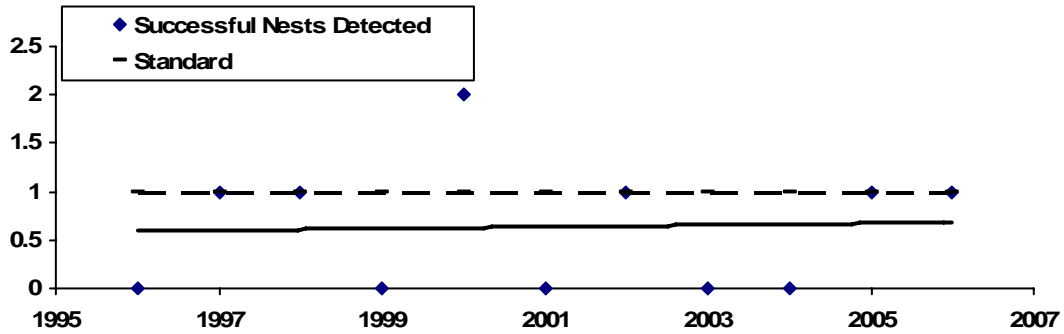
It is conceptualized based on the desired condition that 100% attainment will be met over varying periods of time based on the response of individual Special Status Species to management actions, policies, and naturally occurring environmental conditions (Figure 9-2).

Figure 9-3. Activity trends for a) Northern Goshawk, b) Bald Eagle, and c) Osprey relative to existing TRPA standards.

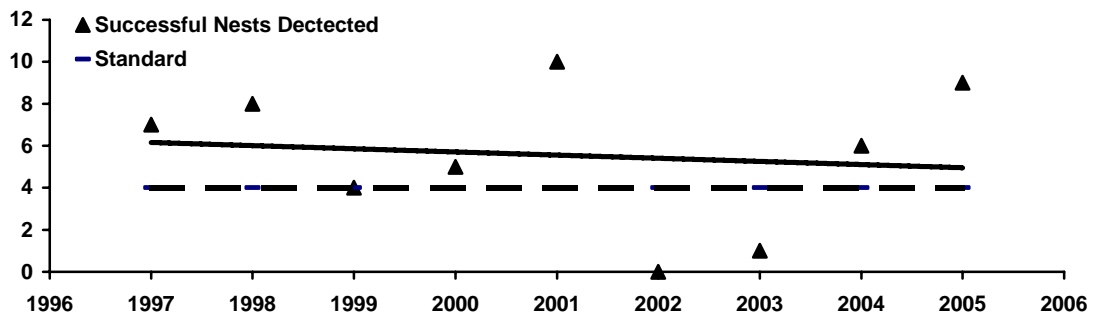
a. Northern Goshawk



b. Bald Eagle



c. Osprey



9.4.4 Proposed Desired Conditions and Standards for Special Status Species

Proposed Desired Condition: Sustainability of Special Status Species
Populations of, and environmental conditions and processes important to native threatened, endangered, rare, special interest or sensitive species are maintained at a sustainable level.

The intent of this desired condition includes the following:

- Key habitats are spatially, physically, and/or temporally buffered from detrimental human activities such that populations of these species are sustained over time.
- Wildlife, fish, and vegetation conservation policies contribute to the de-listing of these species from the sensitive, threatened and endangered list.

Proposed Standard for Special Status Species
At least 20% of the benchmarks for Special Status Species (SSS) are met or exceeded within the first evaluation period. At least 40% of the benchmarks for SSS are met or exceeded by the second evaluation period. At least 60% of the benchmarks for SSS are met or exceeded by the third evaluation period. At least 80% of the benchmarks for SSS are met or exceeded by the fourth evaluation period.

The standard identified for Special Status Species is reasonable in that it provides an opportunity for step-wise attainment over time. Benchmarks have been proposed for some of the Special Status Species but are still in development for others.

9.5 Desired Condition 3: Biological Integrity of Aquatic Ecosystems

The Lake Tahoe Basin is perhaps best known for its aquatic ecosystem. Lake Tahoe attracts millions of visitors every year because of its scale and clarity. Over 330 water bodies and 63 watersheds significantly contribute to the regions biodiversity and natural beauty while also providing people opportunities to recreate and appreciate. Establishing biological integrity as the primary goal for aquatic ecosystem is the first step in protecting life in water because at its core strives to perpetuate the natural heritage of an area. Measuring and evaluating biological activity in aquatic ecosystems is the next step because it identifies ecological risks that are important to human health and quality of life, such as pollution and recreational experience.

Aquatic ecosystem habitats are attributed to multiple categories, including species viability, invasive species, plant and animal community diversity, and human activity areas. These categories and their associated elements of importance are outlined in Table 9-2.

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Table 9-2. Associated Attributes of Aquatic Ecosystems and Attribute Indicators.

| Attribute Category | Importance of Attribute |
|---|---|
| Species Viability | Healthy aquatic environments support viable populations of native plant, invertebrate and vertebrate riparian-dependent species. A viable population is resilient to fluctuations in natural variation of environmental conditions. |
| Alien, Invasive and Domesticated Species | Alien and invasive species reduce native species diversity and habitat quality through competition for resources, predation, or parasitism. Domesticated animals (such as cat and dogs) have been known to chase, harass, injure, and/or kill native biota. |
| Plant and Animal Community Diversity: | Structural diversity and native species composition of plant and animal communities provide habitat and critical ecological functions for native species. |
| Special Habitat Types | Unique aquatic and aquatic-associated habitat types (such as springs, seeps, fens, deciduous riparian and wetlands) contribute to landscape and species diversity. |
| Watershed Connectivity | Spatial and temporal connectivity of aquatic ecosystems allows for unobstructed movement of aquatic and riparian dependent species which contributes to their survival, dispersal, migration and reproduction. |
| Floodplains and Water Tables | Stream channels connected to floodplains during elevated flows sustains diverse habitat types, and improves water quality by trapping sediment and nutrients. |
| Streamflow Patterns and Sediment Regimes: | In-stream flows consistent with natural hydrologic regimes support conditions in which native aquatic and riparian biota have evolved and adapted to. |
| Stream Banks and Shorelines | The integrity of stream bank and shoreline physical structure is important to support vegetation and reduce stream channel erosion. |
| Human Activity | Human activities or past and present management or land use actions can adversely impact the integrity of aquatic ecosystems. |

9.5.1 Proposed Indicator for Biological Integrity of Aquatic Ecosystems

Proposed Indicator for Biological Integrity of Aquatic Ecosystems

Proportion of Aquatic Ecosystem component benchmarks met or exceeded within an evaluation period (as measured with various indexes of biological integrity and other relevant indicators).

For assessment purposes, the aquatic ecosystem will be divided into 4 important aquatic components, including:

- Streams – flowing waters
- Wetlands – areas less than 8 hectares (1 hectare = 2.47 acres) that are significantly influence by the presence of standing or very slow moving water.
- Small Lakes – water bodies larger than 8 hectares and less than the size of Lake Tahoe
- Lake Tahoe

For each aquatic component, an index of biological integrity and/or other relevant indicators are proposed to measure biological conditions. The IBI's will use birds, aquatic insects, fish, reptiles, and amphibians to judge biological condition relative to human influences for each aquatic component.

Key Indicator - Biological Indicators of Aquatic Ecosystem

Similar to the key indicator for the terrestrial ecosystem, the Key Indicator for the aquatic ecosystem is the proportion of aquatic components that have reached or exceeded benchmarks within an evaluation period. Benchmarks will be established that are above a sub-optimal condition (Figure 9-1). The Key Indicator value will provide an overall assessment of the condition of the aquatic ecosystem for the Lake Tahoe Basin. For example, if 2 of the 4 aquatic components are at or above their benchmark in an evaluation period, then the Key Indicator is about 50%; indicating that about 50% of the components are not in attainment. This approach will allow an evaluator to gain an understanding of the aquatic ecosystem as whole as well as alert the evaluator to which aquatic component needs additional management and/or policy attention.

Diagnostic Indicators:

Several diagnostic indicators are proposed to measure aquatic ecosystem component conditions. In general, the index of biological integrity as applied to different taxa (i.e., aquatic invertebrates, birds, amphibians), will be used as a basis for determining the condition of aquatic ecosystem components. Preliminary analysis of aquatic biota data suggests that IBIs will be a useful indicator for aquatic ecosystem condition because, like terrestrial ecosystems, IBI's statistical properties vary with the intensity of human activity and land use.

9.5.2 Current Condition and Trend for Biological Integrity of Aquatic Ecosystems

The plant and animal species composition of the aquatic ecosystem that exists today has been largely influenced by major societal events that occurred in the past. Prior to Euro-American settlement in the Lake Tahoe Basin (pre-1860), the Washoe people had minor effects on environmental conditions. Washoe used some horticultural practices that loosely mimicked natural disturbance to facilitate the growth of important plants

(such as burning, pruning, and weeding) in meadows. However, relatively significant modifications to biophysical condition of aquatic environments occurred after Euro-American settlement.

During the Comstock Era (circa 1860 to 1900) timber harvesting and livestock grazing altered stream flow regimes and significantly increased stream sediment loads. Streams were moved aside to accommodate the removal timber or dammed to provide water for livestock and flume operations. Excessive livestock grazing virtually denuded the landscape of herbaceous vegetation.

Following the Comstock Era (1900 to 1960), livestock grazing continued, however, logging activities substantially declined even though many of the man-made logging features in the aquatic ecosystem persisted. This time period marked the end of the native Lahontan Cutthroat Trout population from Lake Tahoe and adjoining streams. The extinction of this top aquatic predator was the result of a combination of events that included increased sediment loading attributed to grazing and logging, man-made barriers to spawning and historic range (e.g., construction of the Tahoe City/Truckee River dam in 1913), the introduction non-native species such as the lake trout at the turn of the century, and over-harvesting of the species. Towards the end of the era, important components of the stream ecotype were significantly altered to accommodate residential housing. For example, to accommodate the Tahoe Keys development, a fresh water marsh of approximately 750 acres that served as important waterbird and fish nursery habitat, was dredged and filled. Additionally, during this time, several more aquatic species were introduced into Lake Tahoe Basin streams to improve the recreational fishery, including and not limited to rainbow trout, mysid shrimp, kokanee salmon, crayfish, brook trout, and brown trout.

From 1960 to today, relatively rapid urbanization of the Lake Tahoe Basin has occurred. Since the mid 1900's to today, approximately 75 percent of marshes and 50 percent of meadows (feature associated with steams) have been permanently lost or fragmented in the Lake Tahoe Basin. Within the last 20 years however, many beneficial activities have lessened some of the pressures on streams. For example, the TRPA and Lahontan Water Quality Control Board have established non-degradation stream regulations as well as creating a supportive atmosphere for the restoration of altered streams and the recovery of native fish populations.

9.5.3 Technical Range of Feasibility for Biological Integrity of Aquatic Ecosystems

In general, the Index of Biological Integrity (IBI) was identified as the approach most applicable to measuring the health of aquatic ecosystem and to address the monitoring and evaluation needs of Pathway 2007 agencies (based on the Karr and Chu analysis, 1999). The IBI's in development for this effort meets all necessary indicator criteria identified in Pathway 2007 because it is measurable, defensible, related to goals, and understandable.

The overall approach proposed is to assess attainment of desired conditions for aquatic ecosystems (as well as terrestrial ecosystems) is beneficial in that it can summarize the aquatic (and terrestrial) ecosystem as a whole, and could be examined to assess the location where the sample is drawn. As a result, degradation can be tracked specifically to an aquatic component (streams) as well as to a specific location within the watershed. This feature has potential implications for prioritizing restoration projects, measuring the

success of restoration projects, and is directly related to measure progress towards attainment of the desired condition (or standard).

Preliminary analysis of biological data indicates that the various IBI's in development for aquatic ecosystems are viable and appropriate for measuring biological conditions. As discussed above, the key indicator for the Biological Integrity of the Aquatic Ecosystem is based on benchmarks for different aquatic components. The IBI diagnostic indicator represents a gradient of condition and is categorized into three level of condition from unsustainable to sustainable to optimal biological integrity (figure 9-1). A shift in the proportion of sites from unsustainable/suboptimal to sustainable or sustainable to optimal is feasible with the appropriate land use/management policy and restoration. However, the percentage of sites that could feasibly move from unsustainable to optimal is not likely, as many of these sites are degraded as a result of urban development.

Several attribute indicators will also contribute to the Biological Integrity of the Aquatic Ecosystem benchmarks. The current conditions for many of these indicators are unknown at this time so assessing the feasibility of reaching a given condition is not possible at this time.

9.5.4 Proposed Desired Condition & Standard for Biological Integrity of Aquatic Ecosystems

Proposed Desired Condition for Biological Integrity of Aquatic Ecosystems

The functional, physical, chemical and biological integrity of the Lake Tahoe Basin's aquatic ecosystem are maintained at or above a sustainable level.

Similar to the desired condition for terrestrial ecosystems, the proposed desired condition strives to promote the natural condition of aquatic ecosystems. It sets goals to maintain and protect those areas that are in an intact condition and identifies a need to restore areas that are not intact or outside of an expected range of conditions. The Vision statement for wildlife and fisheries and diagnostic benchmarks for aquatic ecosystems provide recognition that some level of impact from human development and high recreational use will persist. The benchmarks, however, leave little room for expanding the influence of residential and commercial development into undeveloped areas.

Proposed Standard for Aquatic Ecosystems

All of the benchmarks for aquatic ecosystem components are met or exceeded within an evaluation period.

Components Include:

- Streams
- Lake Tahoe
- Wetlands
- Small Lakes

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This means that all components must meet or exceed minimum benchmarks for a determination to be made that the desired condition of aquatic ecosystem is being achieved. There are no federal or state standards set for the biological condition of aquatic ecosystems. Consequently, it has been determined that this standard was appropriate and achievable at this time because 85% of the basin is relatively undisturbed from intense human development and activity. Additional analysis and technical/public input is required to fully develop the analytical rationale for setting this standard as well as associated benchmarks for each aquatic component.

Analysis is currently being conducted to establish benchmarks based on diagnostic indicators for the basin's Aquatic Ecosystem components.