

**The Role of Urban Forests in Conserving and Restoring Biological Diversity in the Lake Tahoe Basin (i.e., the LTUB project)**

*A summary of education opportunities, policy considerations, urban lot management recommendations, and monitoring program implications result from this research.*

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Field work for this study was conducted from 2002 to 2005, during snow-free months, throughout Lake Tahoe's urban areas, between 6,250 and 7,500 ft elevation. The final report was submitted to LTBMU in mid-April 2007. According to correspondence with the authors, inferences from this research apply to all urban lots managed by the USFS-LTBMU (as well as other agencies) during snow free months. The research was conducted by researchers and graduate students from USFS-PSW, UNR, and UC Davis, and funded and/or supported by the USFS-LTBMU, TRPA, UNR, UC Davis, CTC, NDSL and USFS-PSW. Overall, the results of this research indicated that open space in the form of "urban lots" significantly contributed to native biological diversity in the Lake Tahoe basin. Policies and actions that supports the purchase, conservation of open space, encourage the enhancement and maintenance of native vegetation throughout residential areas and open space, and that discourage the degradation of riparian habitat in urban areas appear be effective for sustaining native biological diversity.

Below are specific opportunities, considerations, and recommendations that are drawn from and elaborated on from the results of this research by LTBMU staff. The recommendations are organized in four categories including: 1) Education/Outreach, 2) Agency Policy, 3) Urban Lot Management, and 4) Monitoring Program. Where noted (\*) within the context of these categories, additional recommendations are included from other relevant research or common knowledge.

### **Education/Outreach Opportunities**

Many of the opportunities/recommendations revealed from this research include those that deal with improving our publics' understanding of how their land use affects biodiversity on public lands and how modifying their behavior can reduce impacts. Education/outreach opportunities resulting from this research primarily deal with noxious weeds and the control of domesticated pets. Education materials that deal with different issues should be provided in both Spanish and English (and potentially other languages depending on public land visitation patterns).

#### ***Noxious Weeds***

- Provide noxious weed awareness materials (e.g., flyers, posters, brochures) and presentations at events where Forest Service is present. Make sure education material is specific to the weed species found in the basin, provides contact information, and provides residents and visitors solutions to mitigate impacts.
- Fund the production and distribution of noxious weed awareness materials to neighborhoods throughout the basin, especially in the vicinity of urban lots where they have been detected.
- Use LTBMU and TIIMS websites to disseminate noxious weed awareness materials.

- Provide opportunities and events for neighborhood residents and schools to get involved with monitoring and removing weeds from public lands, particularly urban lots. Provide incentives to sustain residents involvement weed monitoring and removal; for example, present contributors with appreciation/recognition awards/plaques.

### ***Domestic Animals (Cats and Dogs) Control***

- Distribute/provide educational materials/information (via website, brochures, flyers, mailings, etc) that will improve residents and visitors understanding of the impacts uncontrolled domestic pets have on native species and habitat quality. In cooperation with local regulatory agencies, provide information regarding USFS policy/CFR's, and local regulations related to unrestrained pets and wildlife harassment. Encourage the restraint/control of dogs and cats when enjoying public lands (USFS lands or otherwise).
- \*Discourage residents from leaving pet food accessible to wildlife. Feed pets indoors and store pet food indoors or in wildlife-proof lockers if possible.
- \*Discourage the use bird feeders because they are likely to artificially inflate the abundance of squirrels and jays in developed areas. Squirrels are known to harass or prey upon nests of native songbirds.
- \*Cats are known to prey upon native small mammals and birds. Cats are also vulnerable as prey items for coyotes. Consequently, keep cats indoors and/or fit them with a collar that makes noise when they move (e.g., attach a bell(s) to their collar)

### ***Residential Development***

- \*Improve visitor and residents management of trash. Encourage use of wildlife-proof garbage storage or reduce amount of time unsecured garbage sits at curbside prior to pick-up. Forest Service staff should continue to support city and county efforts to improve wildlife ordinances through specialist review.

## **Agency Policy Considerations**

Agencies responsible for the rate of urban growth and/or urban design should retain or incorporate policy to 1) improve education of forest users and home owners, 2) support the purchase urban parcels (especially riparian areas and areas that connect areas of open space), 3) retain important habitat features such as brush, snags and downed woody debris where fire and hazardous conditions can be mitigated, 4) actively remove and treat areas infested with noxious weeds, and 5) retain existing land coverage standards by capability type.

### ***Education/Outreach Policy***

- Education and outreach programs should play a prominent role in improving LTBMU's and TRPA's (and others) ability to achieve biodiversity desired conditions for urban lots.

### ***Land Acquisition Policy***

- Agency policy should continue to support the purchase of urban properties with public funds to support multiple resource benefits (water quality, biodiversity, scenic resources). Prioritize land purchases starting with the largest parcels that represent rare or sensitive habitats (e.g., riparian habitats) and/or lands that connect open space.

### ***Management Policy***

- Provide incentives that encourage the retention of native vegetation, and remnant large diameter snags and downed woody debris (where hazardous conditions are not exacerbated and perpetuated). The study results support existing TRPA snag and downed woody debris retention policy.
- Policy should be flexible enough to allow for the restoration of habitats that have degraded as a result of fire suppression over the last 100+ years (e.g., conifer encroachment into meadow and riparian habitat).
- LTBMU and other implementing agency policy should create or continue to support a weed inventory and control program on urban lots.

### ***Residential Development Policy***

- Overall, development that exceeded 40% within 300m of sample sites (located within urban parcels of varying sizes) resulted in significant reduction in biological diversity, even to species that are known to habituate to development (e.g., Stellar's Jay). Development as low as 10% within 300m of sample sites resulted in a reduction in nest success or nesting activity of some common bird species (e.g., Dusky Flycatcher). Ant species richness declined when development exceeded 30% (the current policy related to high capability parcel development). Agencies responsible for setting residential development policy should discourage development intensity that exceeds 30% in residential areas (including infrastructure such as roads and paved bike trails). This policy would be consistent with existing policy for high capability lands as well as policy established for lower capability/more sensitive lands (if implemented according to R. Bailey's (1971) original recommendations, i.e., not IPES).
- Retention of a variety of native vegetation life forms (herbs, shrubs, and trees) and other habitat features (e.g., large diameter snags and downed woody debris) on urban lots and developed parcels could reduce the effects of development on biodiversity. Current TRPA policy that encourages the retention of native vegetation and discourages non-native vegetation on developed lands appears appropriate to sustain biological diversity in urban areas.
- Existing policies that discourage the permanent development and/or long-term degradation of structural, compositional, and functional characteristics of stream zones and riparian habitats are effective at maintaining biodiversity in urbanized areas. Existing policies that encourage the restoration and enhancement of riparian habitats are supported by the results of this research.
- Landscape modeling of various development scenarios (existing, infill 50%, infill 100%, etc) indicated that the quality of habitat in support of various measures of biological diversity will decline. A determination of whether this is significant is needed.

### **Urban Lot Management Recommendations**

According to the project's results, the retention of key habitat features on urban parcels can have a positive influence in maintaining many native species that would otherwise decline. The research recognized a need to balance reducing fuel loads and the maintenance of snags, downed woody debris, and shrub cover on urban lots. Additionally, reducing trail density while providing well-designed trails for forest access along with encouraging forest users to maintain control of dogs will benefit native wildlife diversity in and around urban areas.

***Forest Structure Management Considerations***

- Where appropriate, retain snag volumes of at least 10m<sup>3</sup>/ha (142 ft<sup>3</sup>/acre or about 5 snags/acre > 24"dbh and at least 20 ft tall) on at least 50% of the urban parcels in order to maintain use by a wide range of cavity nesting species. Leave the largest available snags to meet minimum volume retention recommendations and remove smaller diameter material to reduce fire risk. Instead of removing potentially hazardous snags entirely, consider mitigating snag hazards by topping, fencing-off areas, pruning, otherwise effectively stabilizing the snags main stem. The research findings may be contrary to the LTBMU's existing urban management guidelines of retaining 3 snags/acre and 3 pieces of downed woody debris/acre. Insufficient snag stocking/availability in urban areas may contribute to property damage associated with species that create cavities. \*Provision of nest boxes by residents and/or on urban lots may supplement loss of cavities provided by snags, however, would not replace other functional values provided by snags (such as food) for wildlife.
- Sites with high canopy cover and low tree density supported a good representation of insectivores. Thus, forest thinning projects in the urban interface may not impact some segments of Lake Tahoe's native bird community as long as: 1) dominant canopy cover is maintained, 2) large diameter snags and downed woody debris are sufficiently retained, and 3) shrubs and sapling cover is sufficiently retained.
- Minimize ground disturbance and retain saplings and shrub vegetation where site conditions permit and to best balance the need to reduce fire risk and provide suitable habitat.
- The restoration of structural, compositional, and functional characteristic of aspen and other riparian habitats adjacent to develop areas could mitigate impacts to the bird community in more densely urbanized areas.
- Habitat heterogeneity, in terms of vegetation structure and composition, resulted in a more diverse small mammal community. Managers should manage landscapes to support the range of condition that would be expected at the site under a natural disturbance regime. \*Use low-intensity prescribed burning (were feasible) and other vegetation management techniques (thinning, group selection, brush removal) to accomplish habitat heterogeneity objectives (where appropriate).

***Roads and Trails Management Considerations***

- Reduce the extent of non-system roads and trails surrounding neighborhoods where appropriate. Provide logical and well-designed loop trails that discourage the creation of non-system roads and trails, especially in the vicinity of areas with high biological diversity, rare habitats, and areas that support sensitive species. Provide education/interpretation signage at trailheads to encourage users to stay on trail and to keep dogs under control.

***Noxious/invasive Weeds Management Considerations***

- Implement noxious/invasive weed removal on sites with positive detections. Provide protocol for urban lot staff to assess the extent of noxious weeds infestation on urban lots and provide them with the means to appropriately remove them.

***Facilities Management Considerations***

- \* Continue to retrofit USFS/concessionaire facilities (especially campgrounds and other visitor destinations) with wildlife-proof food lockers and garbage storage as appropriate.

## Monitoring Program Implications

The report's results provide a number of biological response variables (metrics) that could be used to assess environmental conditions in the Lake Tahoe basin. These metrics (e.g., abundance of cavity nesting bird species) could assist the Forest Service in understanding to what extent desired conditions are being achieved at urban lots as well as for other areas that are not influenced by urban development. The results demonstrated reference conditions that should be expected in relatively undeveloped areas, and thus important for managers attempting understand to what extent management activities are effecting biological integrity of Tahoe's forests.

### **Habitat Measurements**

- Directly measure human use/activities (include dogs) at monitoring sites.
- At the landscape scale, measure the following variables (using GIS, within 300m):
  - 1) Percent of conifer vegetation cover, 2) Percent of aspen and riparian vegetation cover, 3) overall habitat heterogeneity, and 4) development intensity were most relevant.
- At the site scale (within 30m to 50m), measure to following variables:
  - 1) Development and/or management intensity, 2) human activity, 3) snag volume, 4) large and small tree density, 5) shrub cover, 6) herb cover, 7) meadow cover, and 8) canopy cover.
- Percent bare ground cover may indicate early successional conditions important for some small mammals.
- A measure of habitat heterogeneity around sample sites may indicate conditions that support relatively high levels of small mammal richness.

### **Birds**

- Forest landbird productivity data (i.e., nest success, daily survival rate) was too expensive to collect for the return on information; thus, not cost effective.
- Surveys efforts should be broad in scope in order to assess multiple segments of the bird community.
- The following species or functional groups should be considered for multi-metric index of biological integrity for terrestrial ecosystems because of their response to development, human activity, or forest structure (i.e., a potential result of forest/urban lot management).

<b>Potential Bird Metrics</b>	<b>Demonstrated Response</b>
Band-tailed Pigeon - frequency of occurrence	increase w/ increase in development and human activity
Barn Swallow - frequency of occurrence	increase w/ increase in development and human activity
Brewer's Blackbird - frequency of occurrence	increase w/ increase in development and human activity
Brown-headed cowbird - frequency of occurrence	increase w/ increase in development and human activity
Cassin's Vireo - frequency of occurrence	decline w/ increasing development
Cavity nester - abundance	Decrease w/ decreasing snag volume (which declined with increasing development).
Cavity nester - nest success	Increase w/ increasing canopy cover
Cavity nesters - daily survival rate	decreased in close proximity to development (<50m)

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Chipping Sparrow - frequency of occurrence	decline w/ increasing development
Dark-eyed Junco - abundance	decline w/ increasing development
Dark-eyed Junco - nest success	decline w/ increasing development
Dusky Flycatcher – nest success	decline w/ increasing development
Dusky Flycatcher – abundance	decline w/ increasing development
Ground nesters - abundance	increase w/ herbaceous cover and aspen-riparian & conifer cover
Ground nesters - abundance	Decrease w/ human use
Ground-foraging omnivores	increase with development
Hairy Woodpecker – frequency of occurrence	decline w/ increasing development
Hermit Thrush - abundance	decline w/ increasing development
Hermit Warbler - frequency of occurrence	decline w/ increasing development
Insectivores abundance	increase w/ increasing canopy cover, snag volume, low tree density
Open nesters (ground/shrub) – nest success	decline w/ increased development
Open nesters - daily survival rate	decreased in close proximity to development (<50m)
Pileated Woodpecker - abundance	decline w/ increasing development
Pygmy Nuthatch – abundance	increase w/ increase development
Pygmy Nuthatch – nest success	decreased w/ increase development
Species Richness	decline w/ increasing development
Stellar’s Jay – nest success	decrease w/ increase development and human activity
Stellar’s Jay abundance	Increase w/ increase development
Townsend’s Solitaire - frequency of occurrence	decline w/ increasing development
Tree Swallow - frequency of occurrence	Increase w/ increase development and human activity
Western Wood Pewee - abundance	decline w/ increasing development
Western Wood Pewee – nest success	decline w/ increasing development
White-breasted Nuthatch - frequency of occurrence	decline w/ increasing development

*Small Mammals*

- Small mammal richness and abundance were not good indicators of development or human use (i.e., recreation). However, the overall range of small mammal represented at sample sites reduced with increasing development.
- The following small metrics may be useful in assessing the effect of urbanization and biological integrity:

<b>Potential Small Mammal Metrics</b>	<b>Demonstrated Response</b>
Shadow chipmunk – abundance	Decrease w/ increase in development
Deer mouse – abundance	Decrease w/ increase in development
Long-eared chipmunk – abundance	Decrease w/ increase in development
Northern flying squirrel - abundance	Decrease w/ increase in development
Douglas squirrel – abundance	Increase w/ increase in development
Voles – abundance	Increase w/ increase in development
Golden mantled ground squirrel - abundance	Increase w/ increase in development (weak relationship)
Species richness	Increase w/ increase in development (1000m)
Survival rates	Decrease w/ increase in development
Emigration rate	Increase w/ increase in development
Yellow pine chipmunk – abundance	Decrease w/ increase in development
Small mammal richness	Increase with increased habitat heterogeneity.

*Large Mammals*

- Survey techniques that cast a broad net are recommended to assess the condition of large mammal communities.
- The following large mammal metrics may be useful in assessing the effect of urbanization, forest management, or biological integrity.

<b>Potential Large Mammal Metrics</b>	<b>Demonstrated Response</b>
Presence of American marten	Decreased with increasing development.
Presence of Hares, Rabbits	Decreased with increasing human activity (e.g., with dogs)
Presence of Deer	Decreased with increasing human activity (e.g., with dogs)
Presence of coyote	Increase with increased development
Presence of dogs and cats	Increase with increased development
Presence of raccoon	Increase with increased development
Presence of spotted skunk	Decrease with increased development
Presence of bobcat	Decrease with increased development

*Ants*

- The following ant metrics may be useful in assessing the effect of urbanization, forest management, or biological integrity:

<b>Potential Ant Metrics</b>	<b>Demonstrated Response</b>
<i>Formica cf. siblylla</i> - abundance	Decreased with increased development
<i>Formica ravid</i> a – abundance	Increased with increased development
Log-nesters abundance	Decreased with increased development
Total abundance	Decreased with increased development
Ant species richness	Decrease with increased coverage

*Plants*

- Dominant tree cover and native vegetation cover in general is reduced in more developed areas.

<b>Potential Plant Metrics</b>	<b>Demonstrated Response</b>
Exotic species richness	Increased with increased development
Perennial grass species richness	Increased with increased development
Native shrub cover	Decrease with increased development
Tree density by size class	Decrease in density of smaller tree size classes with increased development.