Effects of Urbanization on Natural Systems

Chapter Goals:
After completing this chapter, volunteers should be able to:

- Understand urban system characteristics.
- Understand and explain the practices and effects of urbanization in natural systems.
- Describe the effects of channelization in urban systems.
- Describe the three broad plant categories in urban systems and the threats to them because of urbanization.
- Describe the fauna of urban systems and the effects of urbanization on these species
- Become familiar with the Best Management Practices (BMP's) for urban areas.

Introduction

Urbanization affects many aspects of natural systems. No matter the level of urbanization that occurs, soils, temperature, hydrology, nutrient cycling, vegetation, and wildlife are altered. This alteration of natural systems can have negative consequences, but not always. There are things we can do to help mitigate the negative effects of urbanization.

An example of the wild land-urban interface is a house adjacent to Forest Service land.
Photo by Bob Nichols, USDA photo center

Urban Zones

Urban areas have been categorized into three zones. **The Rural-Urban interface** is prevalent in Idaho. This zone has disturbed the natural systems the least. There is potential for maintaining relatively natural systems in this zone. For example, it is the best zone for maintaining naturally occurring wildlife because native plants, waterways and space still exist. This zone consists of large lots, or ranchetts. Development is dispersed and often thought of as "country living."

Suburbia is more developed than the rural-urban interface zone. One or two family homes with schools, churches, hospitals, parks and cemeteries characterize this zone (Bolen and Robinson, p. 378). Many neighborhoods in Idaho's towns fit this description, on the outskirts of a larger

metropolitan area, or smaller towns. Most natural systems are disturbed in the suburban landscape. However, wildlife can still exist as remnants of former population and diversity levels. These areas may be dominated by large numbers of just a few species, such as geese, and sometimes non-native animals like starlings, pigeons, and house wrens. This zone represents an area of great potential for wildlife. Backyard habitat programs encourage residents of suburban areas to landscape with native plants and provide nesting boxes and platforms for wildlife. Urban wildlife managers strive for a balance of enticing wildlife to urban areas to meet the needs of people who want and need wildlife and controlling the damage some wildlife can create on personal property. Suburbia can be an especially challenging area for this balance.

A Boise, Idaho subdivision

Idaho Department of Fish and Game's *Backyard for Wildlife* leaflet is an excellent resource to learn more about how to enhance your backyard or office building landscaping to attract native wildlife.

Metropolitan Centers are few in Idaho. As you can imagine, they modify natural systems to a large degree. Open space, parks, and greenbelts are often planned in urban centers to help maintain some natural systems, or at least the appearance of natural systems.

Downtown Boise, though not far from natural habitat, provides little food, water, and shelter for wildlife.

How Urbanization can affect Soils

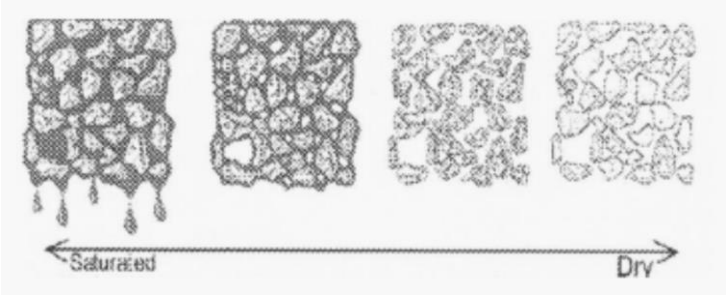
The soils of urbanizing systems are the same as those of the natural systems that exist in the area. The important thing to examine is what happens to our soils during the process of urbanization.

Grading/Scraping

Grading/scraping is one of the most visible effects urbanization has on local soils. New developments often bring in heavy equipment and begin "sculpting" the land to meet project needs. At the low-impact end, this may involve moving soil around and mixing up horizons. At the high-impact end, it may involve completely removing the topsoil and depositing it elsewhere. Removing topsoil eliminates the layer containing organic matter and its associated microbes. It is the organic matter and associated organisms that help make the soil productive. Removing topsoil devastates the soil community.

Compaction

A less visible, though equally damaging, process that happens to urban soil is compaction. Healthy soil is loose and contains many voids, or pockets, filled with air or water. Compaction occurs when anything applies sufficient pressure to the soil to compress these air pockets. Foot traffic compacts soil to a degree. Riding lawn mowers compact the soil to a larger degree. Automobiles compact the soil even more. Bulldozers, road graders, etc. are called heavy equipment for a reason. They are heavy! They cause a great deal of soil compaction.



Pockets between soils may be filled with water or air.

Why is this damaging? Air pockets in the soil provide the oxygen that roots and microorganisms need to function. (It is true that trees take in carbon dioxide through their leaves. However, roots need oxygen to survive.) Without oxygen in the soil, life begins to die. Roots often have a difficult time penetrating and surviving in compacted soil.

Soil compaction not only affects the life in the soil, but also its absorption potential. Loose, aerated soil, with extensive root systems, absorbs a great deal of runoff. When soil becomes compacted, it becomes relatively impervious. Roots can no longer thrive. Water can no longer infiltrate the soil. The result is increased runoff. Water that was once taken up by plants and evapotranspirated, or captured and stored as groundwater, is lost.

Erosion and Sedimentation

Due to construction, urban soil is often left exposed to the elements for extended periods. Wind, rain, and ultraviolet radiation all take their toll on the soil. Wind and rain erode the soil. UV radiation kills the living organisms.

Contaminants

In addition to grading, compaction, and exposure, other urban practices damage the soil. Several homeowners were having problems growing plants in certain areas of their yards. The homeowners were completely puzzled until they dug down and found the contractor who built their homes apparently buried all the scrap mortar, bricks, lumber, etc. in their yards!

Best Management Practices (BMPs) for Urban Soil

Grading and scraping

This will inevitably remain a part of the urbanization process. However, we can work to ensure that it is kept to a minimum. We can also work to require developers to stockpile topsoil and redistribute it once the construction is complete.

Compaction

To reduce or reverse the effects of compaction, we can mechanically aerate the soil. By planting native plants, we can use their extensive root systems to break up the packed soil. We can further aerate the soil by encouraging the growth of soil microorganisms and invertebrates. We can prevent or reduce compaction before it occurs by putting down a 6-8" layer of shredded tree trimmings in areas where there will be pedestrian or vehicular traffic.

Exposure

We can eliminate the impacts of exposure by reducing the amount of soil that is denuded and by mulching all soil that is bare.

Contaminants

We can reduce the contaminants in soil by eliminating toxic pesticides, herbicides, and salt-based fertilizers. We can work to implement stricter controls on developers. We can stop them from burying their construction rubble (scrap mortar, bricks, lumber, etc.) in yards and contaminating the soil.

How Urbanization Can Affect Temperature

Altered Temperature

In urban areas, we see a proliferation of concrete and asphalt as well as a reduction of vegetative cover. This change in the physical character of the land affects ecological factors including the local temperature. Have you ever noticed on the news that the temperatures are generally higher in the city than in the outlying areas? In fact, urban temperatures are on average 1-6 degrees higher than outside the city (Landsberg 1981, and Herold 1991). It is because of this that urban areas are said to be “heat islands.” Two primary factors contribute to this phenomenon.

One contributor to the heat island effect is the urban "hardscape." Concrete and pavement capture heat from the sun and radiate it into the atmosphere well after the sun goes down. This not only increases local temperatures, but also makes them more stable during a 24-hour period.

The other major contributor to the heat island effect is the reduction of vegetation. Reducing vegetative cover does two things. First, it reduces shade. This allows for more of the sun's energy to strike the urban hardscape, and be radiated back into the atmosphere. Secondly, reducing vegetative cover reduces evapotranspiration. Plants lose water to the atmosphere as they transpire. This evaporative process cools the surrounding air. When the vegetation is gone, the cooling effect is gone.

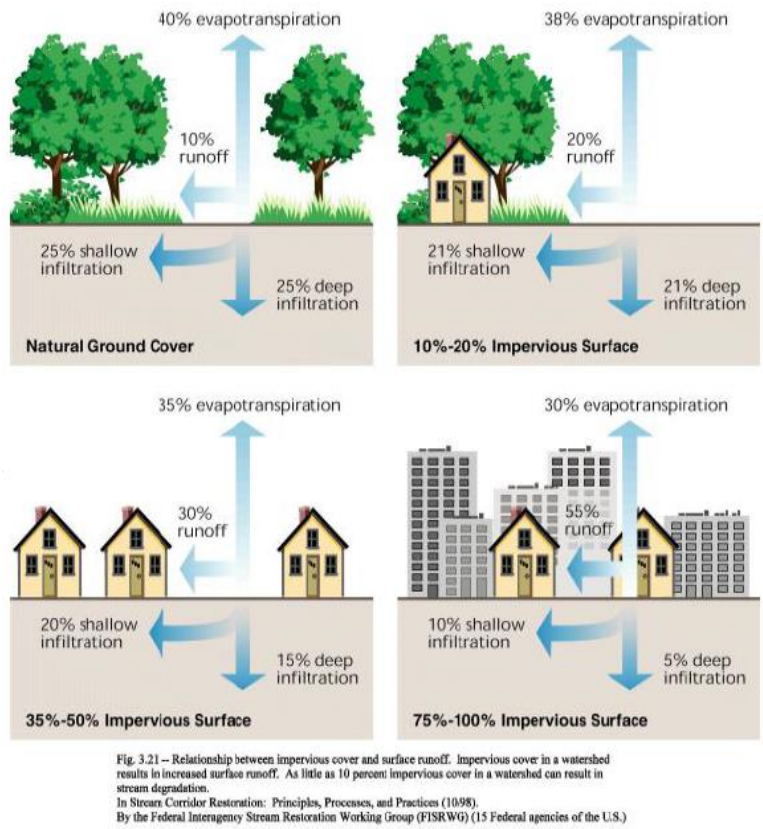


Fig. 3.21 -- Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

Diagram courtesy of The Federal Interagency Stream Restoration Group

BMPs for Altered Temperature

The primary way to reduce this effect of urbanization is to reduce the amount of hardscape (concrete, etc.) allowed and by shading that which is allowed with native vegetation. This one practice would go a long way toward reducing the "heat island" effect.

How Urbanization Can Affect Hydrology

The hydrological cycle can be greatly disturbed in urban areas. Many of the changes occur because of impervious surfacing. Rooftops, parking lots, streets, sidewalks and compacted soil all restrict or eliminate infiltration of water into the soil. Precipitation that once was absorbed into the soil and replenished groundwater supplies now hits these impervious surfaces and becomes runoff. Groundwater supplies diminish while surface runoff is increased.

Groundwater supplies are important because they are often what keep streams flowing during dry times of the year. When excessive, impervious surfacing interrupts the groundwater recharge

process, streams are affected. Because of this interruption, some urban streams are flooded during rainy seasons and go dry when the rains stop.

Contaminants

Urban water is often contaminated by point and nonpoint source pollution. Point source pollution can be traced to a specific point. For example, discharge from a factory. This type of pollution is easy to monitor and control.

Non-point source pollution is that which seems to have no specific point of origin. Rather, it comes from many different sites throughout the watershed. Examples of non-point source pollution are fertilizers and pesticides from yards, petroleum residues from streets and parking lots. Acid rain does not fall just in cities.

As runoff travels across yards and paved surfaces, it picks up contaminants and carries them to the nearest watercourse. Contrary to popular belief, water that enters storm drains does not usually get treated before it enters streams. Sometimes it does, at least through swales, etc. Consequently, streams and lakes contain contaminants.

Although chemical contaminants are a problem in urban streams, ponds, and lakes, they are not the only problem. Increased sediment loads are also a problem. Runoff picks up sediment (from erosion) and carries it into watercourses. The increased volume and velocity of water in streams caused by increased runoff also scours the stream banks, releasing more sediment. Sediment increases the turbidity (cloudiness) of the water. This alters the light penetration level that, in turn, affects the aquatic vegetation. Sediment may also be deposited on the bottom of streams and ponds, covering gravel beds, adversely affecting wildlife.

Sediment in water also increases the temperature of the water due to the sun's ability to absorb darker colors more easily. As water temperature increases, the ability of that water to hold dissolved oxygen decreases. This can be deadly to some fish.

Channelization

To deal with some of these problems, many cities have channelized their streams.

Channelization usually involves removing trees and other vegetation from the stream bank, then sculpting the bank into a smooth, straight channel. This channel may then be seeded with grass or worse yet, lined with concrete. Converting natural streams into concrete channels accomplishes two things. First, a concrete channel conveys more water, more quickly than a natural stream does. Second, lining the channel with concrete separates the water from the soil, thus reducing erosion at a particular site. Channelizing a stream can be useful, but it has problems.

- *Stream Channelization removes the native riparian (streamside) vegetation.* This eliminates habitat for wildlife such as beavers, amphibians, kingfishers, herons, etc. that depend on that vegetation.

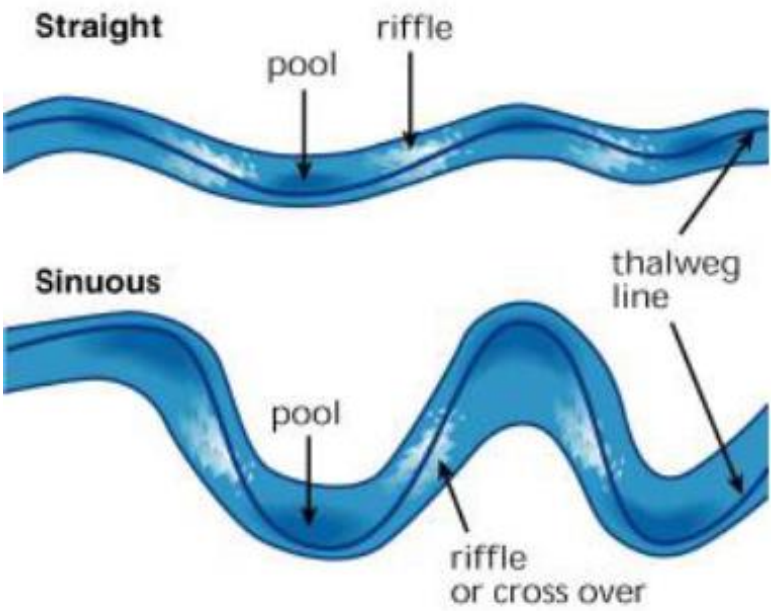


Fig. 1.33 – Sequence of pools and riffles in (a) straight and (b) sinuous streams. In Stream Corridor Restoration: Principles, Processes, and Practices (10/98). Interagency Stream Restoration Working Group (15 federal agencies)(FISRWG).

  Replacing vegetation along streams with concrete eliminates the natural beauty of the stream. Since people prefer to live adjacent to natural areas, (Lane 1991, Adams, Dove, and Leedy 1984) property values tend to be higher. In Wichita, Kansas, lots bordering a wetland sold for 50% more than comparable lots away from the natural area (Ferguson, 1998). Natural areas provide natural beauty. Once that natural beauty is removed, property values are adversely affected.

  Removing the native vegetation along streams eliminates the water polishing ability of the vegetation. It has been widely documented that aquatic vegetation locks up excess nutrients and contaminants found in the water. Wetlands, planted with aquatic vegetation, are currently being used to clean up or polish wastewater (APWA 1981, Hammer 1997). By removing riparian vegetation, we remove its polishing abilities.

  Removing the vegetation along streams removes the cooling effect that shade has on the water. Water that flows down a shadeless concrete channel becomes overheated by the sun, resulting in low dissolved oxygen levels and a reduced capacity for supporting life.

- *Stream Channelization eliminates pools and riffles.* Natural streams usually have a pattern of pool and riffles. Pools are deeper sections with slower flowing currents. Riffles are shallow, with faster currents. These habitats support different plant and animal species. Channelizing a stream destroys these habitats along with the plant and animal species that depend upon them.

- *Stream Channelization harms the food web.* Most stream systems rely on organic material carried in from outside the system to form the basis of the food web. Channelization eliminates some of this transfer.

- *Stream Channelization increases water velocity.* The smooth concrete sides of the stream channel increase the velocity of the water in the channel (Riley, 1998).

- *Stream Channelization eliminates infiltration.* The concrete lining of the channel separates the water from the soil. As water passes down the channel, it is not allowed to infiltrate the soil. Therefore, the amount of water in the channel is actually increased as more is added and none is allowed to infiltrate the ground (Riley, 1998).

- *Stream Channelization increases downstream flooding and erosion.* At some point, the water, with increased velocity and volume, has to be discharged from the channel. When this happens, the area downstream from the channel may be flooded and scoured during peak flows.

- *Stream Channelization increases danger.* Swiftly moving water rushes down these smooth-walled channels.

Water Temperature

The sun heats water in shadeless concrete channels. Parking lots, rooftops, and streets all become very hot during the summer. Runoff, travelling across these surfaces also becomes heated. This heated water enters the streams raising stream temperatures. Populations of invertebrates and other wildlife can be affected by a change of only a few degrees in the water temperature.

BMPs for Altered Hydrology

This is a complex problem that will require a complex, holistic solution.

- *Reduce impervious surface* - Cities must begin to restrict the percentage of impervious surface that a development can have. By doing this, and by aggressively pursuing alternatives to impervious pavement, we can reduce the amount of runoff that is generated.

- *Detention / retention ponds* - We can require developers to deal with runoff they generate on-site. The city of Austin, Texas requires developers to install detention ponds to accommodate the runoff that they generate. It is a start. However, it may not be the best solution. By requiring developers to install a series of swales and retention/detention ponds, we can create wetland habitat and recharge the groundwater supplies while simultaneously accommodating the runoff generated on site.

- *Aquatic vegetation* - We should encourage aquatic vegetation around the edges of ponds. This will not only filter impurities from the water before it reaches streams, but will also provide food and shelter for aquatic wildlife.

- *Regional stormwater wetlands* - We cannot only require developers to deal with their runoff in this way, but entire cities can develop stormwater wetlands to deal with increased urban runoff. These facilities are effective, inexpensive, and create habitat/open space at the same time. For a detailed discussion of creating stormwater wetlands, see *Creating Freshwater Wetlands 2nd ed.* by Donald Hammer or *Integrating Stormwater into the Urban Fabric* (Conference Proceedings). For design specifications for the city of Austin, Texas see Glick and Chang (1998).

- *Upland buffers* - There are benefits to allowing aquatic plants to grow in and around the edges of urban ponds. There are also benefits to maintaining upland buffers of vegetation. These buffer zones provide critical habitat for wildlife associated with the pond, not necessarily in the pond. These zones also help filter runoff before it reaches the pond.

- *Reduce contaminants* - Beyond filtering, we can reduce the damage to water quality by reducing or eliminating contaminants, reduce or eliminate toxic pesticides and herbicides, use organic fertilizers, and use less toxic cleansers.

- *Eliminate channelization* - Channelization is extremely damaging and should be eliminated! It should be replaced by bioengineering methods that use a combination of native plants and manmade design to stabilize stream banks. These methods fix erosion problems and eliminate all of the problems that channelization creates. For a detailed discussion of these techniques, see *Biotechnical and Soil Bioengineering Slope Stabilization: A Practical Guide for Erosion Control*, by Donald Gray and Robbin Sotir, or *Restoring Streams in Cities: A guide for planners, policymakers, and citizens*, by Ann Riley.

- *Encourage prairies* - Prairies have a tremendous capacity to absorb runoff. By planting prairie restorations in currently mowed areas, we can greatly increase the absorptive potential of the land. This will reduce runoff while simultaneously reducing maintenance and providing wildlife habitat.

How Urbanization Can Affect Organic Cycling

Natural ecosystems constantly recycle nutrients. Some urban practices short-circuit this critical process. Grass, leaves, logs, and other organic matter that would ordinarily be recycled are raked,

bagged, and hauled away. These practices remove nutrients and trace minerals from the system. Many people fertilize their property to make up for missing nutrients and trace minerals. Unfortunately, commercial fertilizers can end up in surface runoff, particularly if not applied correctly, and they do not always replace all the nutrients and trace minerals the plants need. This adds to watershed pollution.

BMPs for Altered Organic Cycling

The best ways to deal with altered organic cycling is to re-instate the natural processes of decomposition. Use a mulching mower and allows grass clippings and leaves to decompose where they lay, or compost them and return them to the soil from which they came. In addition to recycling organic matter on site, use organic fertilizers, if needed. These fertilizers are healthier for the soil and do not contain the potentially harmful salts others have.

How Urbanization Can Affect Vegetation

Understory Clearing

The understory is the shrub/ground layer of a plant community. The shrub layer and bottom limbs of trees are commonly removed in urban areas. There may be good reasons to clear understory. Creating play areas for pets and children, protecting your home against wildland fire, and controlling pests might be a few reasons to clear the understory. However, understory may often be cleared just because it is common to do so. There are benefits to keeping understory in place. Wildlife can thrive in the understory.

Many homeowners are concerned about shrubs hiding criminals. Others like the aesthetic of a more open understory. These concerns and values should be balanced with their understory's value to urban ecology.

Fragmentation

Roads, homes, trails, and utility easements all cut into habitats, fragmenting them. Corridors, fragments, and barriers are all related. A strip of woodland stretching across grassland to connect two forest fragments acts as a travel corridor for the woodland species. It also acts as a barrier, which fragments the grassland habitat.

Edge Created

As habitat is fragmented, "edge" is created. The zone where two biomes (or habitat types) meet is termed the "edge." For every home or ball field built, every road cut, edge is created. This effect can have significant impact on wildlife.

Restoring Natural Vegetation in Urban Systems

What natural vegetation would be growing where you live if your home were not there? In many cases, planting native shrubs, grasses, shrubs, and other species requires less additional irrigation and fertilizer and helps wildlife. Local Extension offices can recommend native landscaping materials for your site, and direct you to places where they can be obtained.

BMPs for Altered Vegetation

- *Understory* - We simply must stop clearing understory! This practice is much too damaging to our forests and their associated wildlife to allow it to continue. We must educate neighbors, city employees, and law enforcement officials about the value of this layer of the forest. We must work tirelessly to protect and restore understory in our cities.

- *Fragmentation* - We can work with homeowner's associations, city planners, and private landowners to minimize fragmentation, create and maintain habitat corridors that connect existing fragments of habitat.

- *Edge* - We can work with planners, city officials, developers, and others to locate trails, roads, etc. where they reduce fragmentation and the resulting edge habitat.

Flora of Urban Systems

As an area undergoes urbanization, a pattern begins to emerge which categorizes plant communities into three broad categories (Adams, 1994). These are; natural remnants, derelict lands, and planted communities.

Natural Remnants

Despite urbanization, remnants of the natural vegetation often persist in pockets or patches within the city. These remnants retain the characteristics of the native plant community that existed before urbanization and are often blessed with a diversity of species and physical layering. These remnants face many threats once they become surrounded by urbanization.

- *Fragmentation* - As these patches become smaller and the distance between patches becomes larger, pollination and dispersal of species becomes increasingly difficult. In addition, as naturally vegetated remnants are carved up, specimens that were once found within the fairly protected interior must now deal with the harsher conditions found at the edge of the habitat (wind stress, increased temperature fluctuations, etc.).

- *Altered hydrology* - Urbanization affects the local hydrology. This inevitably affects the hydrology of the natural remnant plant communities persisting in urban areas. Species that can tolerate the change may persist. Those that cannot, disappear.

- *Exotic species* – Exotic species often spread from surrounding neighborhoods to take over the remnants. Common exotics found in our Idaho's natural systems include:

  - Musk Thistle
    Carduus nutans
  - Orange Hawkweed
    Hieracium aurantiacum
  - Perennial Pepperweed
    Lepidium latifolium
  - Perennial Sowthistle
    Sonchus arvenis
  - Poison Hemlock
    Conium maculatum
  - Puncturevine
    Tribulus terrestris
  - Purple Loosestrife
    Lythrum salicaria
  - Rush Skeletonweed
    Chondrilla juncea
  - Russian Knapweed
    Acroptilon repens
  - Yellow Toadflax
    Linaria vulgaris
  - Black Henbane
    Hyoscyamus niger
  - Buffalobur
    Solanum rostratum
  - Canada Thistle
    Cirsium arvense
  - Common Crupina
    Crupina vulgaris
  - Dalmatian Toadflax
    Linaria genistifolia ssp. *dalmatica*
  - Diffuse Knapweed
    Centaurea diffusa
  - Scotch Broom
    Cytisus scoparius
  - Scotch Thistle
    Onopordum acanthium
  - Silverleaf Nightshade
    Solanum elaeagnifolium
  - Skeletonleaf Bursage
    Ambrosia tomentosa
  - Spotted Knapweed
    Centaurea stoebe ssp. *micranthos*
  - Syrian Beancaper
    Zygophyllum fabago
  - Tansy Ragwort
    Senecia jacobaea
  - Toothed Spurge
    Euphorbia dentata
  - Yellow Starthistle
    Centaurea solstitialis
  - Hoary Cress
    Lepidium draba ssp. *draba*
  - Houndstongue
    Cynoglossum officinale
  - Japanese knotweed
    Polygonum cuspidatum
  - Johnsongrass
    Sorghum halepense
  - Jointed Goatgrass
    Aegilops cylindrica
  - Leafy Spurge
    Euphorbia esula
  - Matgrass
    Nardus stricta

- Dyer's Woad
  Isatis tinctoria
- Eurasian Watermilfoil
  Myriophyllum spicatum
- Field Bindweed
  Convolvulus arvensis
- Giant knotweed
  Polygonum sachalinense
- Meadow Hawkweed
  Hieracium caespitosum
- Meadow Knapweed
  Centaurea debeauxii ssp. *thuillieri*
- Milium
  Milium vernale

Vacant Lots / Derelict Lands

These properties can be found along fence lines, roads, in neighborhoods, etc. They have been disturbed by construction at some point so succession has been set back. Therefore, these lands are characterized by invasive exotic species (such as those listed previously) and native pioneer species (such as Ragweeds).

There are several problems with these types of lands. First, like remnants, they are often small patches of habitat that are disconnected. They are often low in biodiversity with some of the plant species (Ragweeds) producing copious amounts of allergens. Because of neglect, they are often "weedy" in appearance.

Planted Communities

This category of vegetation represents the majority of the urban area. It is largely artificial. The landscape is usually highly structured requiring extensive maintenance to keep it that way. The use of exotic species in traditional landscaping is most common. Many of these species come from Europe and Asia. As a result, these landscapes often require a great deal of water, fertilizer, and pest management.

Typical Landscape Structure

Most every home or business will have a row of evergreen hedges around the perimeter of the building. These are called "foundation plantings." Unwanted views will usually be "screened" with a row of evergreen hedges as well. Large shade trees may have grass beneath them, or a groundcover of some type. Often, you will see a flowerbed at the base of trees. Throughout the landscape, there are often beds designed to contain flowering perennials to add color. But quite frequently, the landscape is dominated by vast expanses of mowed grass.

Turf grass is a non-native species and provides very little for most native wildlife species. Lawns like this one require water and fertilizer to keep it green. Water being pumped out of rivers to irrigate lawns, and the use of fertilizers, are both harmful to wildlife.

Why does our society seem to be in love with the monotonous, sterile lawn? To understand this affinity for the lawn, we must examine our culture's history. According to Warren Schultz's book *A Man's Turf; The Perfect Lawn* (1999), small strips of lawn began to show up in formal gardens in Europe during the 17th and 18th centuries. It was also during this time that vast expanses of short grass began to show up in the European countryside. Originally, these vast expanses of grass were kept grazed by flocks of sheep. The larger the expanse, the more sheep the landowner had. The more sheep he had the wealthier he must have been. Therefore, vast expanses of short grass became a symbol of wealth and power.

Many of the early colonists that came to the U.S. came from this cultural influence. George Washington was one of the first to install a lawn around his home (Schultz, 1999). However, the lawn was still not a common sight. It was primarily for the rich. The lawn, as we know it today, did not start to become popular until the late 1800's. The development of "improved" turfgrass varieties were pushed by the golf industry, which was in its infancy at this time. This, combined with the invention of the lawn mower, made the lawn available to the common homeowner. The lawn became a "transition zone" from the hard street to the softer and more welcoming living room. The lawn today has come to be a symbol of territory creating a sort of a "green moat" around our homes. Schultz (1999) says that a well-kept lawn has come to indicate that the man of the house is powerful, in control of nature, and is taking care of business at home. He also states that a well-kept lawn announces to our neighbors that we are abiding by the rules of society. These messages and practices would be acceptable, if traditional landscaping was ecologically sensitive, or even neutral, but it is not. Traditional landscaping creates many ecological problems.

- *Exotics* – As discussed earlier, exotics are often used in traditional landscapes. To survive, these exotics require maintenance that is more intensive. Some may escape into our natural systems and become invaders, upsetting the species composition of those systems.

- *Pollution* – Traditional landscaping requires extensive maintenance. This maintenance significantly increases the pollution in our urban areas. Running a lawn mower for one hour releases as much hydrocarbon into the air as driving a car for 11.5 hours (Schultz, 1999). In addition to the increased atmospheric pollution, traditional landscaping practices significantly decrease our water quality. According to Schultz (1999), 70 million pounds of chemicals are applied to lawns in the U.S. each year! The majority of these chemicals are washed into our local streams and reservoirs.

- *Increased demand on water supplies and facilities* - Exotic landscapes require more water than native ones. This increase in demand puts more pressure on water supplies

than is necessary. The increased levels of toxins in water increase the demand on water treatment facilities.

- *Loss of habitat* - As exotics replace native plants in the landscape, habitat is lost. As native plants are lost, food sources and shelter are lost. The practice of removing the emergent vegetation along the edges of urban ponds eliminates entire populations of wildlife.

Overall results of these practices cause habitat in urban areas to be simplified. At worst, it is completely destroyed. However, the history of our landscapes may not be the future. In the words of Schultz (1999), "The lawn will shrink, no doubt about it, and be replaced by meadows, prairies, woodlands, and hardscaping." What do you think?

BMP's for the Flora of Urban Systems

- *Natural Remnants and Derelict Lands* - The BMP's for these two categories can be discussed together. First, these lands should be protected from development and fragmentation by any means possible. They provide valuable open space within the urban fabric. Second, these lands need management. Exotics that have escaped into these areas should be removed and the natural plant community should be replaced where it has been lost. Third, these areas need to be used in educational programs so that the public understands their value and appreciates them.

- *Planted Communities*

    - Reduce lawn - Vast expanses of lawn are low in biodiversity yet they are economically and ecologically costly. In 1990, there were 30 million acres of lawn in the U.S. The average 26 Urban Systems cost per year to maintain an acre of lawn is $327.00 (Schultz, 1999). The average cost to maintain lawns in the U.S. each year is around 9.8 billion dollars! According to Schultz (1999), there are 70 million pounds of chemicals applied to lawns each year! The best way to reduce these costs is to reduce the amount of lawn in our landscape.

    - Use natives - Using plants native to the local ecological region helps reduce cost of maintenance while providing wildlife habitat. Natives require little to no fertilizer or pesticides. Once established, they require little to no supplemental water as well. Natives can be used in the home landscape, or they can be used to recreate or restore entire plant communities such as prairie plots or native woodlands.

- Leave snags - As you now know, snags are as important to the forest and its associated wildlife as living trees. Therefore, these landscape features should be retained

Fauna of Urban Systems

All of the practices and characteristics of traditional urbanization exert pressure on wildlife populations resulting in radical, yet predictable shifts in the species composition.

Altered Species Composition

We have discussed the soil, vegetation, hydrology, and ecosystem processes in urban areas are disturbed. These perturbations change the environment and the wildlife capable of surviving there. As traditional urbanization occurs, some predictable shifts in wildlife populations emerge.

- *Predators* **-** Traditional urbanization selects for small, adaptable predators. As mentioned earlier, urbanization fragments habitat. Large portions of intact habitat decrease or are lost entirely. Large predators require large territories to hunt. As habitat is lost, they decrease. In contrast, small, adaptable predators (such as raccoons or coyotes) actually increase in numbers. These predators do not require large territories and often find ample prey (rodents, pets, bird eggs) in cities.

Raccoons are generalists and thrive in urban settings.

- *Generalists* **-** As a rule, specialists decline in urban areas. Specialists are those species that have very strict requirements (such as diet or nesting site specifications) for survival. As traditional urbanization alters our natural systems, specialists cannot adapt. Generalists, on the other hand, are capable of adapting. Because of decreased inter-specific competition, reliable food supplies, etc., generalists not only survive in urban areas, but also do very well.

- *Exotics* **-** Exotic species that thrive in our cities are generalists. As their numbers increase, they can even begin out-competing native species. European Starlings, Pigeons, and European (House) Sparrows are all non-native birds that thrive in an urban environment.

- *Edge Species* **-** Habitat often is fragmented in urban areas. This increases edge habitat while reducing interior habitat. A corresponding shift in wildlife follows. Those that prefer edge habitat increase.

The European Starling is an example of an exotic generalist in an urban setting.

- *Granivores/Omnivores* - Along with all of the other shifts, similar shifts can be seen according to feeding preference. Generalists are usually omnivores, so they increase. Urbanization allows another group to increase. Many people have provided birdseed for many years. The result is an increase in granivores (seedeaters), (Adams, 1994).

- *Effects on Behavior* - It is not only the species composition that is affected by traditional urbanization. Behavior is affected as well. As artificial food (birdseed, trash, and pet food) increases, the need for traveling large distances to eat decreases. This results in smaller home ranges for many urban species (see Adams, 1994 for a summary of pertinent literature). As discussed earlier, urban environments are "heat islands" and are warmer in the winter. This stability of temperature allows for longer breeding seasons (see Adams, 1994 for a summary of pertinent literature).

- *Wildlife Conflicts* - Because generalists do very well in urban areas, they will often reach population densities higher than densities found in rural areas (Adams, 1994). As these densities increase, conflicts between humans and wildlife are bound to occur. A wild animal may become a problem if it takes up residence in an attic or beneath a house. Wild animals and pets may not get along. To avoid problems, it is usually enough to eliminate food supplies or shelter opportunities that attract the offending critter. Do not leave pet food out overnight. Secure trash can lids. Seal all outside access points to the attic or under the house. Trapping and relocating the animal does not work. Research shows that the relocated animal will most likely die (Adams and Leedy, 1991). If the situation that allowed the animal to become a nuisance is not corrected, a "new" critter will simply replace the "old" one. If these simple suggestions do not eliminate the conflict, see Living with Wildlife by Diana Landau and Shelley Stump and The Humane Control of Wildlife in Cities and Towns by Guy R. Hodge for additional help solving wildlife problems.

BMP's for Urban Fauna

The goal for implementing BMP's for urban fauna is to increase densities of some species of wildlife while limiting the densities of others. This can often be tricky. In general, this can be accomplished by increasing natural food sources and shelter opportunities while eliminating or reducing manmade ones. To do this, these suggestions are offered:

- *Do not provide supplemental food* - By throwing out food scraps, you are feeding overpopulated wildlife. Species like raccoons, skunks, grackles, etc. love to get supplemental food. To help limit their numbers, do not provide supplemental food.

- *Do not provide accidental food* - Accidental food includes pet food, spilled birdseed, and trash. Take precautions (secure lids to trash, clean up bird seed, store seed and pet food in side, do not leave pet food in the dish overnight) to ensure that this type of food

is not available. Only the overpopulated species use these food sources. Eliminating these sources will help limit their populations.

- *Do provide natural food* - Plant native plants! Food sources, such as berry-producing shrubs, flowers, etc., attract wildlife that is not overpopulated in urban areas.

- *Do not provide accidental shelter* - Accidental shelter includes attics, sheds, under houses, etc. The species that use these shelter opportunities are not the ones we need to be helping. Seal all openings and not allow access.

- *Do provide natural shelter* - Plant native plants! Native vegetation and snags provide shelter for native wildlife that we want to attract.

- *Provide a variety of water* - Water attracts all types of wildlife. Be sure to provide various types water features in different parts of the landscape. Provide a small pond, with moving water, in one area and a birdbath in another, etc. Doing this will increase the diversity of wildlife that can use your landscape.

- *Actively manage pest species* - Pest species include non-natives as well as a few prolific natives. Do not allow Starlings or House Sparrows to nest or feed in your landscape. Physically remove their nests and use feeders that do not allow them to feed. Do not allow rodents to live in your home. They are not the native ones. Trap them and eliminate them. Prolific natives, such as grackles, like to have canopy trees with mowed lawn beneath them. Landscape your yard so these natives do not prefer your yard. By reducing the populations of pest species, and increasing the populations of others, we will increase the wildlife diversity and have much healthier populations overall.

References and Credits

Author:
John Davis
Urban Wildlife Biologist
Texas Parks and Wildlife Department

Editor:
Michelle Haggerty:
Texas Master Naturalist Program Coordinator
Texas Parks and Wildlife Department

Significant Modifications:
Chris Schnepf
University of Idaho Extension-Kootenai County

Sara Focht
Watchable Wildlife Program Coordinator
Idaho Department of Fish and Game