# Designing for Wildlife in the City




http://www.blackredstarts.org.uk/pages/greenroof.html

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# Abstract

We may not think of cities as “wild”—cities are built for the habitation of humans, as places for people to live separately from the “wild.” But wildlife is all around us. The wildlife, the non-human animals native to the area, are often displaced to the fringe, moving unnoticed through the city, or considered ‘pests,’ but in other cases, they are valued and enjoyed.

Wildlife in the city can create both problems and benefits for city residents. Every city is different, with different native species in and around it, but some kind of wildlife exists in each one. Many cities have in some ways grown to accept and appreciate the native wildlife of their areas, and even make space for them in the city in ways that benefit both the wildlife and the human inhabitants. As cities and suburbs grow, urban interactions with wildlife will likely only increase as people move further into wildlife habitat. An urban design that takes other species into account can establish a successful relationship for both parties, now and in the future.

This project will examine the way that different cities, with different climates and cultures, have incorporated non-human animals into design plans, using three case studies that show how cities can be designed with wildlife in mind:

- 1. Green Roofs in London
- 2. Tifft Nature Preserve in Buffalo, NY
- 3. Park Connector Network in Singapore

# London: Green Roofs


Map: By User:vigi veranda (File:World_Map_Blank.svg) [Public domain], via Wikimedia Commons

Photo: Blackredstarts.org http://www.blackredstarts.org.uk/pages/greenroof.html

# Green Roofs

* **Green roofs** are roofs of buildings that are partially or entirely covered with vegetation, for the purposes of providing insulation, reducing the 'heat island' effect in cities, absorbing rainwater, and creating a wildlife habitat, among other things.

A green roof on the Horniman Green Building, London

# London Green Roofs: Background

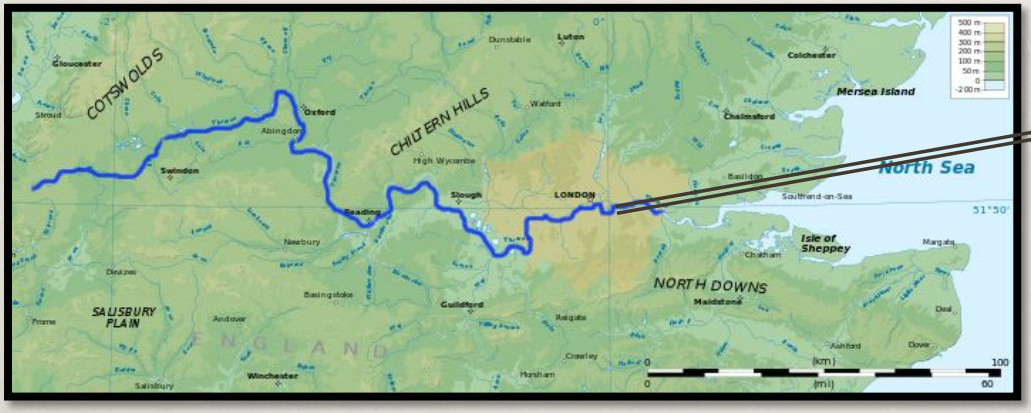
In the 1980s, the London government began encouraging the **redevelopment of abandoned sites** around London. But ecologists soon realized that many of these targeted areas for redevelopment had been **colonized by wildlife**. Specifically, the area along the Thames River that flows through London—the Thames Corridor—was a target for regeneration and was found to be the home of much native wildlife.

*The first **green roofs** in London were created in the 1980s by architects with the philosophy of **"footprint replacement:"** the idea that when new development causes a loss of green space, that green space should be replaced on the roof of the new buildings.

*Although green roof technology had been used since then, green roofs had been minimal.

*In the **1990s**, a group of conservationists and ecologists in southeast London realized the potential for green roofs as wildlife habitat, to **mitigate the impacts of redevelopment**. They began encouraging planners and developers to consider green roofs on new building sites.

Specifically, the push for installing green roofs turned to focus on the conservation of one species: **the black redstart.**




The River Thames.
Flappiefh, via Wikimedia Commons

A site along the River Thames, designated for redevelopment.
Danny Robinson [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

# About the Black Redstart

The black redstart is **one of Britain's rarest birds**. It is a small passerine bird with features similar to a robin, and its name comes from the dark gray body and orange-red colored tail of the male. The black redstart is found throughout southern and central Europe, Asia, northwest Africa, as well as Great Britain and Ireland.

The bird requires areas of spare "wasteland" vegetation and stony ground for feeding, and have often been found on brownfield sites. As a reference to its preferred habitat, the black redstart has also been called the **"bomb-site" bird**.

The Black Redstart, one of Britain's rarest birds, has dark grey and orange-red coloring.
Photo by Karunakar Rayker via *Wikimedia Commons. http://commons.wikimedia.org/wiki/File:Black_Redstart.jpg*

Approximate range of the Black Redstart
http://commons.wikimedia.org/wiki/File:A_large_blank_world_map_with_oceans_marked_in_blue.svg

Approximate Distribution of the Black Redstart in England. Green=Resident; Yellow=Summer; Blue=Winter; Red=Passage.
Source: RSPB.org. http://www.rspb.org.uk/wildlife/birdguide/name/b/BlackRedstart/index.aspx

### *Conservation Concern*

Although not an endangered species, there are fewer than 100 breeding pairs in the U.K., so it is listed on the **amber list of Birds of Conservation Concern**. The bird is also protected under the Wildlife and Countryside Act of 1981, which made it illegal to disturb nests or kill birds—and impacted the construction of new buildings on sites with nesting birds.

Greater London is the most important breeding area in the UK for the species; about **10-30% of the redstart breeding population resides in London**. For this reason, the black redstart was listed as a **priority species in the London Biodiversity Action Plan of 1996.**

# The "bomb site" or "power station" bird

http://www.blackredstarts.org.uk/pages/sitesurvey.html

*Typical Black Redstart habitat*

Black redstarts originally lived in stony mountain areas, but by 1900 began inhabiting urban areas. They are fond of industrial, built sites; thus, they tend to concentrate near cities. There is evidence to suggest they adapted to the urban habitat. They are often spotted on broken down buildings, brownfields and other sites of urban wasteland.

Black Redstarts.org http://www.blackredstarts.org.uk/pages/ecoredstart.html

# Black Redstart Roofs

One of the wildlife species found to have colonized abandoned areas targeted for regeneration was the protected species, the black redstarts--particularly the area along the Thames River that flows through London. Redevelopment and cleanup of sites along the Thames threaten the species' habitat.

When the London Biodiversity Action Plan of 1996 listed the black redstart as a priority species, the **Black Redstart Action Plan** for London was devised for the bird's conservation. Similar to the idea of "footprint replacement," conservationists realized the need to replace redstart habitat when the bird's preferred habitat was threatened by development.

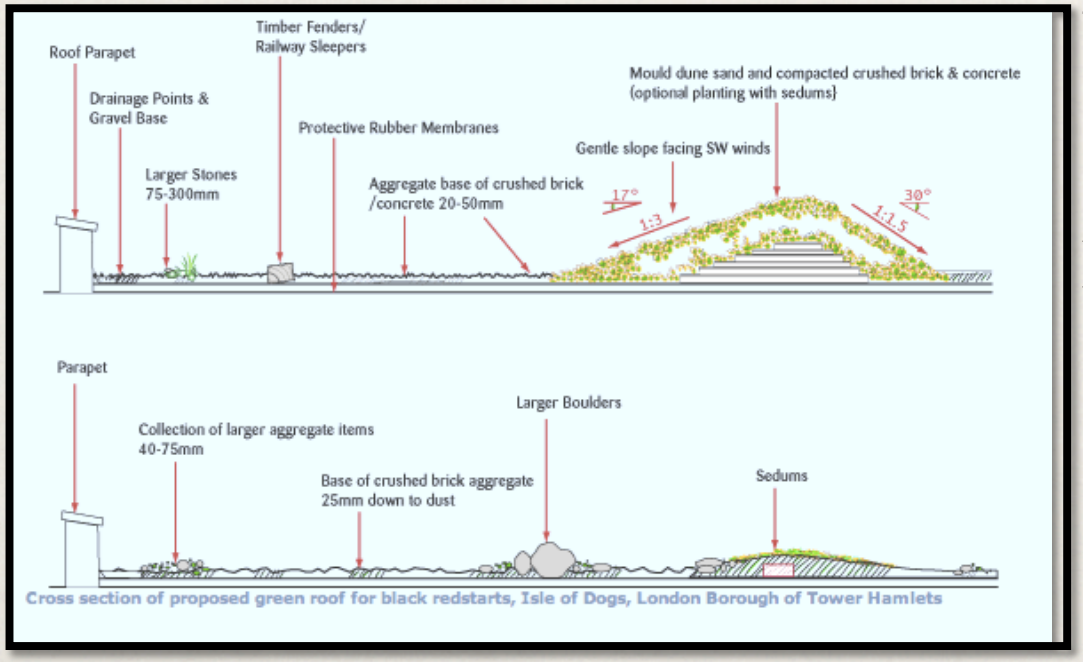
***In 2002, the Greater London Authority estimated that 25% of the important wildlife sites in Greater London were sites designated for redevelopment.***

Green roofs were chosen as a method of replacing their habitat. Made out of construction materials of crushed concrete and brick, these specific green roof designs were called **'brown roofs,' 'rubble roofs,' 'eco roofs,' and 'redstart roofs.'**

***The first brown roof in London was constructed in 2002.***

One of the first "brown roofs," constructed on the Laban Dance Center in southesastern London.
http://livingroofs.org/20110502300/world-green-roof-policies/history-of-green-roofs-in-london.html

# *London: Green Roofs*




The design for a "brown" roof. It includes a mixture of concrete and crushed brick, ideally rubble from the site on which the roof's building is constructed, in order to replicate the conditions being replaced.

http://www.blackredstarts.org.uk/pages/greenroof.html

Rubble

By Onderwijsgek (Own work) [CC-BY-SA-2.5-nl (http://creativecommons.org/licenses/by-sa/2.5/nl/deed.en)], via Wikimedia Commons

Example of a green roof system. Green roofs typically consist of a waterproof membrane, a root barrier, a growing medium, and vegetation.

By thingermejig (flickr.com) [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

## Other Benefits of Green Roofs:

* Flood alleviation
* Water conservation
* Reducing heat island effect
* Mitigation for Climate Change
* Air Pollution
* Improved building appearance
* Overall Biodiversity: providing usable habitat for many different species—particularly rare invertebrate species, hoverfly, butterflies, bees, swifts, bats, house martins, house sparrows

## Successes:

Black redstarts have been spotted on these new green roofs—including sightings in 2013 on a green roof on the London Olympics site. Redstarts spotted on roofs have been considered an indicator of green roof success.

Urban planning departments in London have actively promoted the use of green roofs, and by 2008, an estimated **500,000 square meters of green roof space** had been added in London.

The 2011 London Plan states that "major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible" (Greater).

The plan cites the primary benefits of green roofs for London as adaptation to climate change (aiding cooling), sustainable urban drainage, enhancement of biodiversity, accessible roof space, improvement to appearance, and growing food.

The Mayor's target is a **5% increase in green roof cover by 2030**.

Evelyn Simak [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

Info: Greater London Authority. "The London Plan: Spatial Development Strategy for Greater London. July 2011.
London's Approach to Green Roofs, Livingroofs.org, http://livingroofs.org/20110502300/world-green-roof-policies/history-of-green-roofs-in-london.html

## Challenges:

*The initial push for green roofs for biodiversity was slow. The conservationists involved with promoting green roofs had little knowledge of the technical details for installing green roofs, and many ecologists and developers weren't initially convinced of the plan's merit.

*There has also been little guidance for planners and architects on how to install green roofs in London or what kind of green roofs to install.

*Installation of a green roof can sometimes be cost-prohibitive.

*Primary additions of green roofs have been on new buildings rather than on existing ones; one of the main issues has been how to retrofit existing buildings with green roofs.

*Not all building roofs are suited for heavy loads of substrate, and research on the best types of substrate is still being conducted.

*As redstarts are often difficult to find, knowledge of breeding sites and distribution of the species is still incomplete.

# Analysis:

Black redstarts have been spotted on these new green roofs—and redstarts spotted on roofs have been considered an indicator of green roof success. But they are still rare sightings in London, and the black redstart is still on the amber list of Birds of Conservation Concern.

Thus, "brown" roofs may not have become entirely successful as redstart habitat, yet—and it remains to be seen how future development and green/brown roof installation will affect the populations in the city.

***Beyond the Redstart***

Although the black redstart was the impetus for more widespread research and implementation of green roofs, the London government's current primary concern regarding the use of green roofs is for **future resilience in the face of climate change**.

It seems the most successful aspect of the push for "brown" roofs in London today may be not its significance for the black redstart, but rather its larger impact on the increased installation of green roofs for their wide variety of benefits besides the conservation of one bird.

This case shows how London placed value on its wildlife, how other species can be incorporated successfully into cities as cities grow, and how existing city structures can be altered in simple ways for the conservation of wildlife in the city. As green roofs have become popular in many cities all over the world, this case of a specific type of green roof has relevance beyond London and the black redstart.

Siva301in, http://commons.wikimedia.org/wiki/File:Black_Redstart_bird.jpg

# Buffalo, NY: Tifft Nature Preserve


Map: By User:vigi veranda (File:World_Map_Blank.svg) [Public domain], via Wikimedia Commons

Photo: Buffalo Museum of Science, http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/tifft-photos/

# Tifft Nature Preserve

Tifft Nature Preserve is a **nature refuge and urban wildlife sanctuary** along Lake Erie in Buffalo, New York. The preserve consists of 264 acres of land and also functions as an environmental education center and recreational area for city residents. The preserve includes five miles of nature trails, three boardwalks, guided tours, fishing, cross-country skiing, and "the opportunity to view local wildlife in natural habitats" (Buffalo).

Tifft Nature Preserve's Logo: Buffalo Museum of Science, http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/tifft-photos/

The preserve **attracts a variety of wildlife species** and provides nesting habitat for rare marsh birds and acts as an important stopover site for migrating birds.

Tifft Nature Preserve has been called an "oasis of wilderness surrounded by concrete, pavement and steel" (Adams & Lowell, 68).

Tifft Nature Preserve
Source: Buffalo Museum of Science: http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/

*An "oasis of wilderness surrounded by concrete, pavement and steel" (Adams & Lowell, 68)*

Buffalo Museum of Science, http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/tifft-photos/

# Tifft History

The land of Tifft Nature Preserve has a long and interesting history. Before becoming the "oasis" it is today, the Tifft Nature Preserve was previously a dairy farm and stockyard, owned by a man named George Washington Tifft, then a railroad/shipping center, and then a city and industrial waste site in the 1950s and 1960s. In 1982, the Preserve became part of the Buffalo Museum of Science.

Dairy Farm & Stockyard →
Railroad/Shipping Center→
City & Industrial Waste Site (1950s & 60s)→
**Today: Urban Wildlife Sanctuary**

**Then** **Now**

The site of Tifft Nature Preserve when it was a railroad/shipment center, and the site today.
Source: Buffalo Museum of Science,
http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/

# The Process

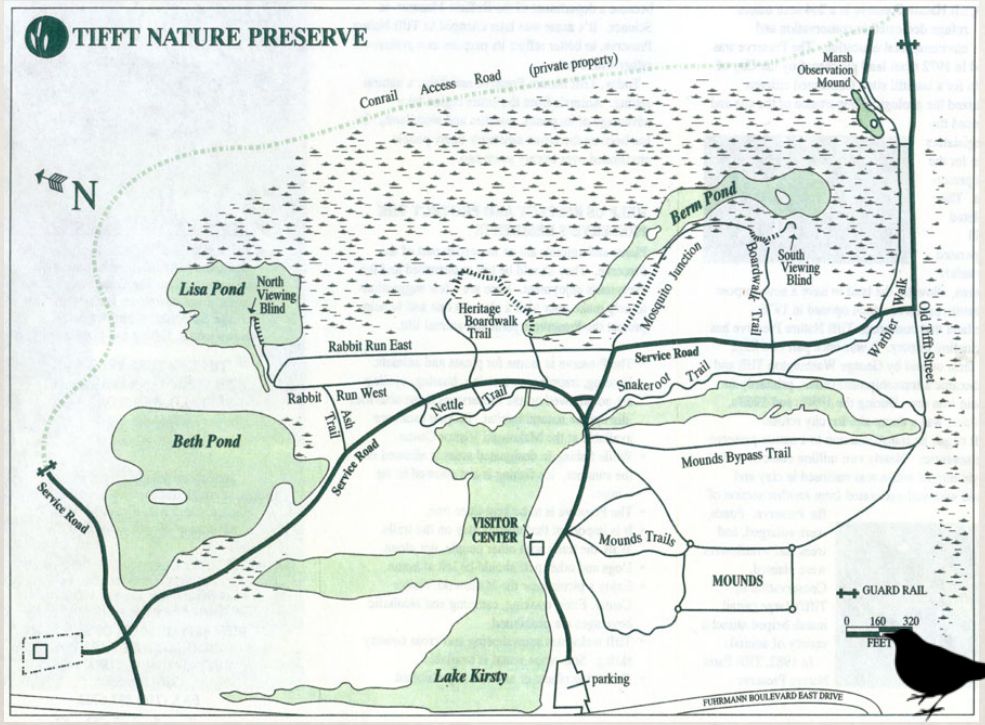
This transformation was **led by a group of citizens**. In the 1970s, a group of Buffalo area residents recognized the area's ecological significance and potential for recreation. They encouraged the city of Buffalo to convert the area into a nature preserve, and the plan was accepted.

To transform the land into a nature preserve, the city of Buffalo undertook the following steps:

1. About two million cubic feet—or approximately 15 million gallons—of municipal waste that had been collected on the land was covered in clay and soil.

2. Ponds were enlarged, and trees, grasses, wildflowers, legumes and shrubs were planted to provide food & cover for wildlife. The area's natural cattail marsh was conserved for the benefit of wildlife.

3. The vegetation was left to "naturalize" for 10 years before further development.




This is the current map of Tifft Nature Preserve, showing the visitor center, trails, observation areas, the expanded ponds, and the extensive undeveloped land area and cattail marsh.

Source:
Buffalo Museum of Science,
http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/tifft-map/

# Successes: Wildlife

Osprey & Toad
Buffalo Museum of Science http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/tifft-photos/

Bluebird
By Ken Thomas (KenThomas.us (personal website of photographer)) [Public domain], via Wikimedia Commons

Red fox
© Srcromer | http://www.dreamstime.com/ Dreamstime Stock Photos & http://www.stockfreeimages.com/. Stock Free Images.

The Preserve was certified as an **Urban Wildlife Sanctuary** by the National Institute for Urban Wildlife in 1987.

The Preserve attracts:
- 175 species of birds
- Mammals including fox, deer, and beaver
- A large variety of reptiles, amphibians, fish & invertebrates

Management Techniques:
- Bluebird nest boxes
- Nesting platforms for geese, osprey
- Brush piles for rabbits

- The Preserve's **75-acre cattail marsh**—the largest remnant wetland habitat in the county—provides nesting habitat for rare marsh birds.

- The Preserve was designated as an **IBA (Important Bird Area**) by Audubon.

Cattail Marsh
Source: Fall Cattails, Valstateparksstaff, via Wikimedia Commons

# Successes: People

City residents initiated the plan to turn a waste site into a nature preserve, and today, **thousands of visitors visit Tifft Nature Preserve each year** to experience its offerings, including nature tours, nature camps, hiking, snowshoeing, cross-country skiing, bird watching, and other educational and recreational opportunities.

The preserve also makes a useful site for scientific research, encouraged by its association with the Buffalo Museum of Science.

The Tifft Nature Preserve Management Plan states that "the Buffalo Museum of Science is committed to protecting the significant natural resources on the preserve and achieving the full potential of Tifft Nature Preserve as a destination for scientific research and environmental education" (Spiering, 4).

Bird watching and Fishing at Tifft Nature Preserve
Buffalo Museum of Science, http://www.sciencebuff.org/tifft-nature-preserve/about-tifft/tifft-photos/

# Challenges

- Time: Initial recovery of the vegetation was a long process.
- Non-native species: Invasive species are currently a major threat to the preserve's natural resources, including invasive plants taking over the cattail marsh and mammals such as white-tailed deer.
- Management:
  - Power Line management: A number of power lines run through the preserve. Power companies need access to these lines, adding a management issue for the areas around the lines.
  - Management of the Public: As an area for public recreation and education as well as conservation, rules are needed to maintain natural resources. Some of the necessary rules include:

•Stay on the trails
•Do not litter
•Do not disturb the wildlife or other visitors
•Do not feed the wildlife
•Do not pick or eat plants
•Do not collect/release animals
•Do not collect deer antlers

• Do not bike, swim, boat or jog
• Do not sled or fly kites
• Do not go on the ice
• Do not hunt, trap or build fires
• Do not cook at picnic tables
• Do not bring alcohol
• No ATV's or snowmobiles(All-Terrain Vehicles)

*-Tifft Nature Preserve Management Plan, 2009*

# Analysis

Tifft Nature Preserve has become a successful "urban oasis" with a multitude of benefits for both urban wildlife and city residents.

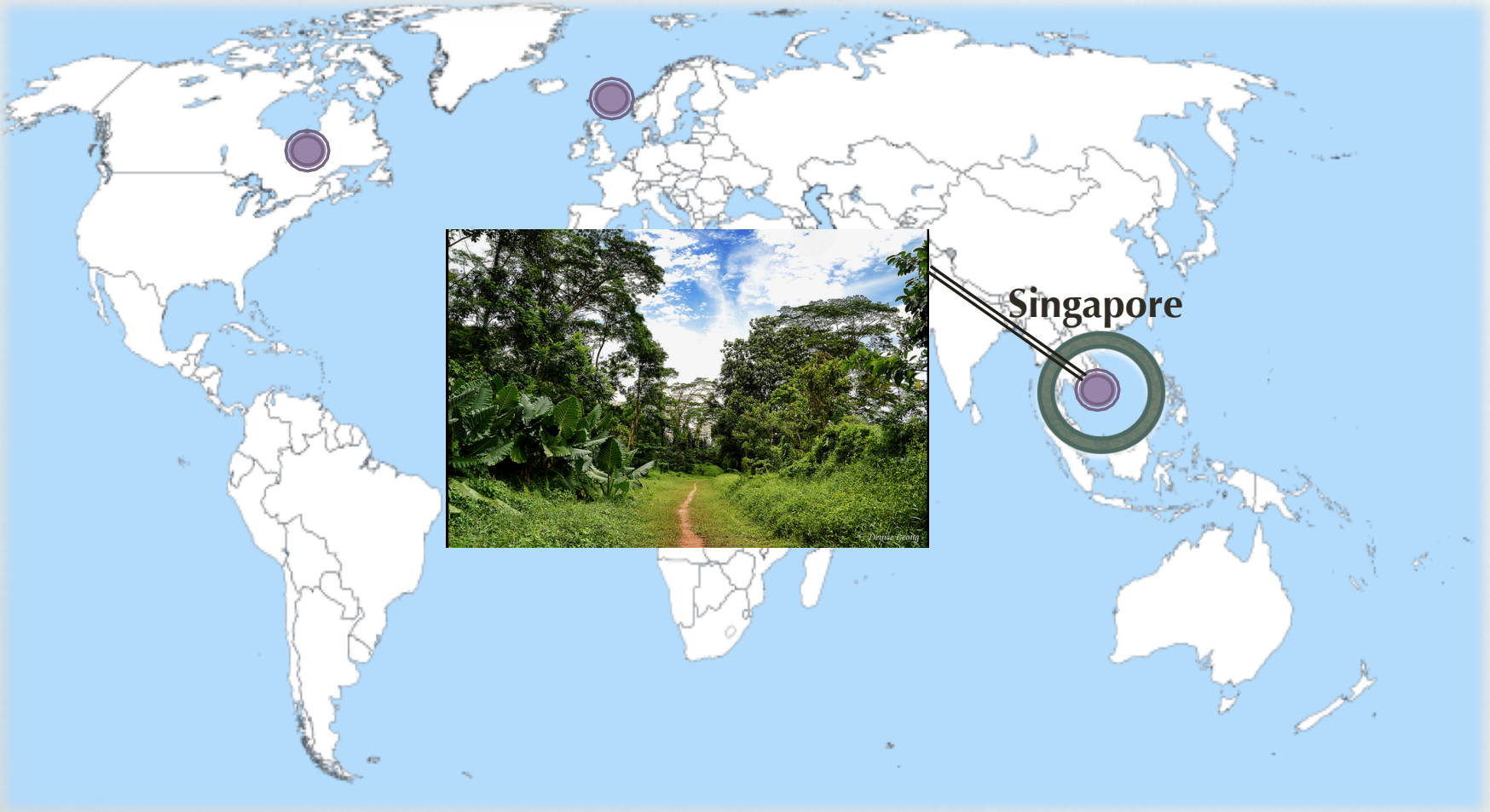
While brownfield sites were preserved for black redstarts in London, the Tifft Nature Preserve reused a brownfield site to create a nature preserve.

As a place frequented by visitors, and as climate, wildlife, and people's priorities change, ongoing management is needed to keep the preserve successful.

This case is an example of redesigning and reusing spaces within the city in ways that benefit both humans and wildlife, and of managing both wildlife and humans. The initiative of citizens who valued recreational opportunities in nature, and a responsive city government, made the plan successful.

*-Tifft Nature Preserve Management Plan, 2009*

# Singapore: Park Connector Network




Map: By User:vigi veranda (File:World_Map_Blank.svg) [Public domain], via Wikimedia Commons

Photo: Denise Leong viahttp://www.thegreencorridor.org/photos/

# Singapore: Park Connectors

By Vardion, via Wikimedia Commons

By Data: National Aeronautics and Space Administration (NASA). Image: Dave Pape. [Public domain], via Wikimedia Commons

Singapore is a small island with a large population of both humans and wildlife. By 1990, urbanization covered over half of the island's land area. This led to a **75% disappearance** of native species.

However, even though Singapore has one of the highest population densities in the world, almost half of the land is still green space—but it's not all connected (Soderstrom, 130).

The city developed a plan to connect its green spaces using a **network of green corridors,** which they termed **'park connectors.'**

By William Cho [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

## Goals:

***National Parks Singapore:***
***"Let's make Singapore Our Garden"***

1. Recreation: The Singapore government perceived a need for increased recreational opportunities on the island. The National Parks Board designed the **Park Connector Network (PCN**) to link major parks so that people can run and bike around the island.

2. Conservation of native flora & fauna: They hope to enhance biodiversity in Singapore through increased vegetation and connecting parks and green areas for wildlife travel and habitat.



Examples of green corridors in Singapore.
By Denise Leong viahttp://www.thegreencorridor.org/photos/

# Singapore Park Connector Network (PCN)

**Singapore:**

- 682.7 square miles of land
- >6,000 people/square km
- Rich biodiversity, with habitats including tropical rainforests, mangroves, and coral ecosystems


By Sengang (Own Work) via Wikimedia Commons


By ペウゲオト. (Own work.) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

Singapore's PCN uses the concept of a **green corridor:** also known as wildlife corridor or habitat corridor, an area/pathway of habitat connecting populations of wildlife that have been separated by human populations and development.
Their purpose is to help prevent the negative impacts of habitat fragmentation, including inbreeding and genetic drift.

# Singapore Wildlife

**Crab-Eating Macaque**
Andre Ueberbach, via Wikimedia Commons

**Crimson Sunbird**
National Parks Singapore Annual Report, 2012-2013: http://www.nparks.gov.sg/cms/docs/annualreport/7_To_Cherish_Our_Biodiversity.pdf

**Singapore is home to:**

- 60 mammal species
- 365 bird species
- 107 reptile species
- 28 amphibian species

- 1194 native plant species; 675 of which are critically endangered (32%)

**Green Crested Lizard**
By Lip Kee Yap [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

**Barred Buttonquail**
By Savi.odl (Own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

**Malaysian Plover**
By Lip Kee from Singapore, Republic of Singapore (Malaysian Plover (Charadrius peronii)) [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

**Slow Loris**
By Silke Hahn via Wikimedia Commons

*Info: Singapore Red Data Book, http://www.nparks.gov.sg/cms/docs/redbook/RDB_Flora_final.pdf*

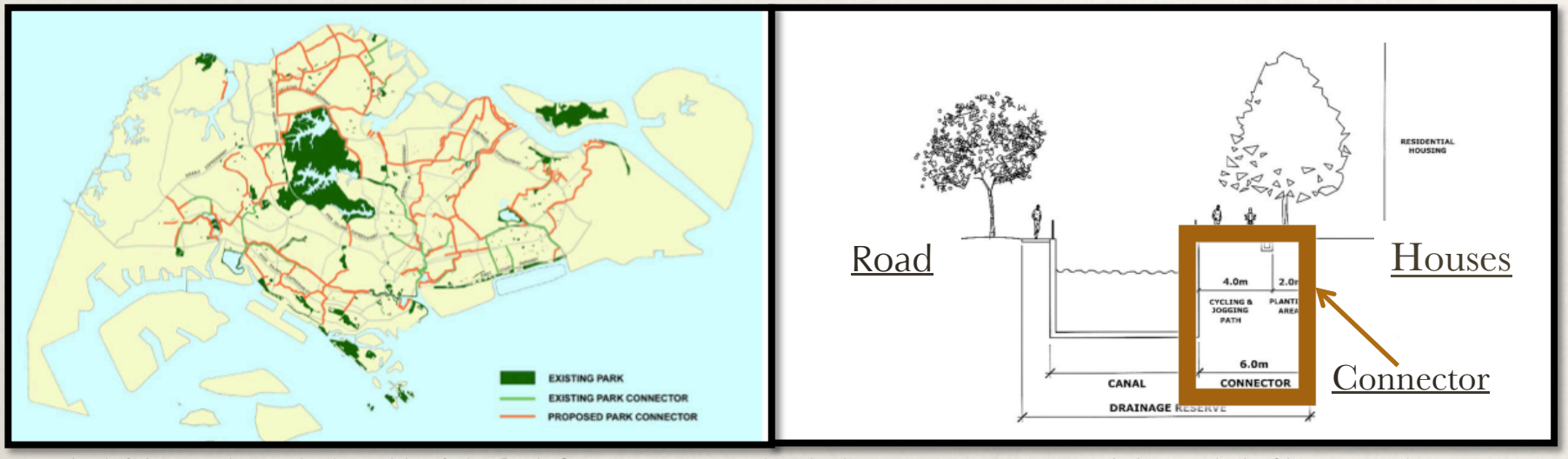
*Singapore: Park Connector Network*

# The Plan

*The greenway movement in Singapore began in the 1980s, and the plan for a green corridor network in Singapore was approved by the Garden City Action Committee on **December 4th, 1991**. The plan was included as part of the 1992 Singapore Green Plan. The project was viewed as having low financial requirements, and it called for using under-utilized land that is already reserved as drainage buffers in water catchment areas.

*The plan was estimated to take **30 years to complete**, and **360 km (186 miles) of park connectors**—the extent of which can be seen in the image below.

*The park connectors generally consist of a minimum of 4m of asphalt tracks lined with at least 2m of dense vegetation, built through parks and residential areas.




The left image shows the breadth of the Park Connector Network. The larger green areas are existing parks in Singapore, the green lines are existing park connectors, and the orange lines are proposed park connectors as of 2006.

The image on the right shows a general design plan for an area of park connector along a drainage reserve near city housing.

Source: Tan, Kiat W. "A greenway network for Singapore." *Landscape and Urban Planning.* Vol. 76, Issues 1-4. 30 April 2006. Pg 50.

# The Park Connector Network (PCN)

The first park connector network in Singapore was built in 1995, and by January 2012, the Singapore Ministry of National Development announced that **200 km of park connectors had been completed**.

Singapore's Park Connector Network currently consists of about 42 complete connectors. Each connector creates an unobstructed pathway for running, biking or walking between parks and recreation areas.

To get around roads and other obstacles, traffic lights, underpasses or bridges are used.


By Sengang (Own Work) via Wikimedia Commons


The original design called for the use of drainage reserves for connectors, but the plan has expanded to roadways, and there is a push for the transformation of railways into green corridors as well.

By ペウゲオト. (Own work.) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

# Human Benefits

* Increased recreational opportunities: Bike & foot paths
* Community Bonding: The Singapore government recruits volunteers to work as guides for navigating the park connectors, and organizes path work days and community bike rides through the pathways, encouraging Singapore residents to help build, enhance and enjoy the park connector network.
* Climate mitigation: Dense vegetation provides much-needed shade in Singapore's warm climate
* Environmental & Appearance Improvement: Increase in overall greenness of city

**"Fancy park hopping on foot, by rollerblades or on a bicycle?"**
**"Enjoy the lush greenery. Feel the breeze as you meander leisurely along our rivers and canals. Park connectors treat you to a myriad of sensory delights and adventure that only Mother Nature can offer."**

*-National Parks Singapore Website:*
*http://www.nparks.gov.sg/cms/index.php?option=com_visitorsguide&task=parkconnectors*

# Successes

**"A model for greenway planning"**

*-Kiat W. Tan, "A greenway network for Singapore"*

Singapore's vision of an island-wide park connector network has implications for human recreation, wildlife, and overall city health and greenness, making Singapore a "suburban mosaic of high-rise apartments with managed interconnected spaces" (Douglas 271).

Surveys conducted have shown that residents appreciate having the park connectors nearby. They found that people use the corridors for running, biking, rollerblading, walking dogs, relaxing, nature watching, and even for traveling to work or school (Briffett).

Buangkok Park Connector.
By Sengkang (Own Work) via Wikimedia Commons

Alexandra Arch, part of the Southern Ridges park connector.
By edwin.11. (Flickr: Alexandra Arch.) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons

While some corridors have attracted more wildlife than others, **about 90 species of birds** have been observed in the corridors.

Surveys have found that birds feed, sing, mate and nest in the corridors, using both natural and man-made features of the network.

For these reasons, Singapore's Park Connector Network has been called "a model for greenway planning" (Tan 2006).

# Challenges

1. Competition for land: as such a small island, every inch of space counts, especially as populations grow and development expands. Limited land calls for the need to optimize and design multifunctional spaces.

2. Effectiveness for Wildlife Conservation: The benefit of green corridors for wildlife has been debated. Areas with more frequent human presence and vegetation preening are found to foster less biodiversity. And green corridors are not effective passageways for all species—one size does not fit all.

3. Time: Implementing a city-wide scale of networks is time-consuming; greenways are still being built & enhanced—and the plan has been extended for another 20 years.

4. Maintenance: As the greenways extend through every community on the island, National Parks must work with community leaders in hopes of engendering a sense of ownership of the park connectors among leaders and the public in order for the plan to succeed. This requires marketing, networking, money, and education.

5. Native vs. Non-Native Species: Around 2001, ecologists observed that much of the vegetation in greenways were not native species, and did little to help attract local, native birds and wildlife. Thus, they began planting local native plants to encourage rare native species to return (Soderstrom, 125).

# Analysis

This case provides a unique example of a city-wide design taking wildlife into account with especially limited land resources, using a combination of conservation biology and landscape design. This is a government- rather than citizen-led effort, and the government faces the challenge of garnering public support for its push to make Singapore greener and enhance biodiversity.

Indeed, Singapore faces many obstacles, including a rapidly growing human population that shares limited land space with wildlife. The research on the actual benefits for wildlife populations by the development of green corridors has so far been somewhat inconclusive, and thus the success of this case for animals in the city may be debatable. Time will tell as populations and green corridors expand.

However, surveys on the public's enjoyment of green space, nature, and the availability of outdoor recreation have found high appreciation and use of the park connectors.

In 2012, the Ministry of National Development announced its **plan to build another 100 km**, as well as 20 new parks, over the next 5 years. As park connectors in Singapore are still maturing and still being constructed, so the full impact of these green corridors is yet to be seen.

# CONCLUSION

These 3 cases showed 3 different approaches to thinking about, managing, and integrating wildlife in an urban setting: green roofs for the conservation of one avian species in London, a nature preserve for conservation and recreation in Buffalo, and green corridors for the connection of parks, people, and wildlife in Singapore.

Each case had its own goals, priorities, obstacles and successes. They all address the ever-present issue of human-wildlife interactions in the city. As human populations expand and cities delve further into wildlife habitats and territories, this issues of wildlife conservation and human-wildlife interactions will likely only grow. Continuous management, research, public support and education will be necessary to form the most successful relationships in the future. Every city has different wildlife to consider and thus different management issues, but these cases represent different possibilities that have had some success designing for wildlife in the city.

Despite the many difficulties, the value these 3 cities have placed on their native wildlife, and the involvement of individuals at both the citizen and government level, suggest a value and significance of wildlife for even the non-"wild" urban habitat. And while enhancement of biodiversity was a primary goal of each of these cases, each realized the many benefits reaped by city residents of preserving and caring for nature in the city, as well.



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