I. Biodiversity is sometimes positively correlated with urbanization – why?
   1. More energy means more species.
      a. More specifically, more energy (e.g. NPP – net primary productivity) means more individuals which means more species.
      b. So, more energy means more people and more species.
      c. The pattern between individuals and species richness might differ between urban and wildland areas too.
      d. But it may be MORE complicated – maybe more records means more species observed. At smaller scales this relationship (HPD and diversity) breaks down.
   2. Grain size is an important determinant in the form of this relationship.
   3. Species richness is affected by other factors such as housing age, isolation, habitat heterogeneity, and proportion undeveloped. Though these impacts usually are more obvious at smaller spatial scales.
   3. Highly urbanized areas tend to have low biodiversity however. Very few taxa have richness peaks in urban cores.
      a. Plants tend to have increasing richness with higher urbanization but only to a point.
      b. Animals (verts and inverts) are often very sensitive to urban impacts.

II. Biodiversity within urbanized areas
   1. Biodiversity is often correlated with amount of green cover/native vegetation.
   2. Remnant vegetation and ruderal or abandoned habitats often harbor higher biodiversity.
   3. Gardens can have surprisingly high species richness.
      a. Often a large proportion of these species are non-native.
      b. The total area of domestic gardens can make up 23% of the area of a city (e.g. Sheffield).
      c. Area is an important determinant of plant species richness in gardens – even more so for natives than non-natives.
      d. Gardens can be important homes for other species including insects.
   4. Sometimes biodiversity is found in unexpected places, such as street medians! In New York City the area of street medians is correlated with the diversity of ants found within them.
   5. Socioeconomics can have controlling influences on biodiversity.
      a. Over time, biodiversity might decline in greater numbers in “wealthy” areas relative to “poor” areas. Why?
      b. Indirect impacts can also affect biodiversity, e.g. through urban heat island effects and socioeconomics (e.g. Phoenix).
      c. Effects can be complicated by socioeconomics!

III. Extinction and urbanization
   1. Plant extinctions in cities have occurred throughout the world – interestingly Hong Kong has a relatively low extinction rate. The prob. of ext. depends on
plant traits (e.g. growth form, spread, dispersal, pollination, seed mass, height).
2. Many insects have been lost from Rome over time.
3. Xerces blue went extinct in 1941 as a result of urban development in SF.
4. Many species have been lost in Singapore and many more are projected to go extinct if similar trends continue. What about Hong Kong?

IV. Case studies in Urban Conservation
1. So why conserve urban biodiversity? Preserve local biodiversity, corridors, understand environmental change, environmental education, ecosystem services, ethical responsibilities, improvement of human well-being.
2. The Bay checkerspot butterfly (*Euphydryas editha bayensis*) was once a common butterfly but is now endangered and has experienced numerous population extinctions. But why?
   a. Development – Many pops. had their habitat literally paved over. This probably happens to many species, but not often documented.
   b. Nitrogen deposition – Caused the establishment of many non-natives.
   c. Non-native plant species – Displaced the native host plant of the butterfly and caused serious declines.
   d. Climate change – One of the first species where we observed a northward/poleward range shift due to global warming.
   e. All of the above – All of these threats cause synergistic effects.
   f. Now it’s listed under Endangered Species Act and it is undergoing highly intensive management (e.g. assisted colonization).
3. Griffith Park is in the middle of Los Angeles. What has happened to its species
   a. There are significant knowledge gaps in our understanding of the world’s biodiversity.
      i. Urban – We haven’t been studying urban areas for that long.
      ii. Tropical – Most studies ecological studies from Europe/ U.S.
      iii. Time – Historical datasets are difficult to come by.
   b. Griffith Park is a 1700ha park surrounded by urbanization.
   c. We are fortunate to have a master naturalist (John Adams Comstock) who collected all the butterflies he could in the early 1900s.
   d. Many species began disappearing from L.A. as early as the 1920s, some going nearly entirely extinct.
   e. We found 39 (out of 55) butterfly species and believe 10 were extirpated (18%). Likelihood of extirpation depended upon the butterfly’s host plant status, dietary specificity and dispersal ability.
   f. Interestingly, we found one species (that was discovered in the park in 1927) thought to be extinct but is critically imperiled.
   g. And there’s a mountain lion (P22) in the park now!
   h. Urbanization has caused extirpations and near extinctions – but there is hope in our urban parks!
4. Bird diversity in a Beijing urban park