I. Framework for thinking of urban restoration

1. Case study: Recall the bay checkerspot butterfly. Habitat is being lost due to invasive species (as is often the case for urban species). What do we do?
   a. We can take measures to reduce invasive species but to what end?
   b. What did California’s grassland look like historically?
   c. Tim’s experiment found that invasives could be reduced by changing soil conditions. And maybe this could be used to create novel habitat.
2. Restoration efforts often have a reference condition or baseline.
3. For “novel ecosystems” returning to a reference condition can be difficult or impossible. Restoration then becomes a difficult concept.
4. There are multiple trajectories from initial (degraded conditions) to restoration targets including enhancement, rehabilitation and restoration.
   a. Reclamation can be a “function” approach that goes part way in restoring to the restoration target.
   b. Or targets can be defined as alternative stable states.
5. Some efforts of reconciliation ecology have emerged that work within human dominated ecosystems and aim to increase biodiversity in them.
6. One approach to reconciliation ecology is the use of natural analogues in the encouraging of biodiversity (e.g. faclons in urban canyons).
7. The emergence of novel ecosystem/ reconciliation type approaches has caused some controversy in the field of conservation and restoration.
   a. E.O. Wilson suggests that these approaches amount to “giving up”.
   b. Emma Marris has championed the “Saving Nature in a Post-Wild World” approach.

II. Urban restoration approaches and examples

1. Urban soils are an important component of the ecosystem. In Chicago an invasional meltdown is occurring such that the build of litter of a non-native plant causes earthworms to persist resulting in a cycle.
   a. Using resilience theory we can identify points within the cycle which are key for intervention.
   b. By breaking the cycle we alter the system and (hopefully) stop the meltdown.
   c. “The tale of one or two cities is inadequate.” (Pavao-Zuckerman 2008)
   d. Baseline conditions for urban soils are especially difficult.
2. Urban stream restoration can improve conditions… but not always. Why?
3. Urban grasslands can be centers for biodiversity.
   a. In Germany this has been demonstrated quite nicely. Restoration efforts (e.g. seeding) have resulted in increased diversity and species richness in urban centers (and improvements over time).
   b. Often relatively cheap to restore urban grasslands but also offer good potential in increasing biodiversity.
   c. However, we need better specification of restoration targets, accounting and long-term monitoring.
4. Urban wetlands are often hotspots for “mitigation.”
a. Hong Kong Wetland Park was initially designated as an “ecological mitigation area” for Tin Shui Wai New Town. Was it effective?
b. There are different types of wetland restoration including enhancement, creation and mitigation banking.
c. The efficacy of urban wetland restoration varies widely.

III. Urban planning and green infrastructure

1. We’ve seen many examples of urban green spaces (UGS) being important. So how do we plan and incorporate UGS into cities?
2. UGSs can be multifunctional, are more optimal with high connectivity, and must be integrated, socially inclusive and long-term in their planning.
3. There are a variety of techniques for improving green infrastructure and ‘building for biodiversity’:
   a. Green roofs – Offset the vertical displacement of habitat and a variety of ecosystem services.
      i. Intensive green roofs are typical “garden” type green roofs with deep soils, big plants, irrigation, high maintenance.
      ii. Extensive green roofs are modern roof-top gardens with more “ecological functionality”. They typically consist of shallow soils, small plants, and require little maintenance.
      iii. Ecosystem services of green roofs: carbon sequestration (not really though), net GHG emissions (but goes both ways), cooling, stormwater mitigation (generally a big effect), water quality (complicated effects – new green roofs can contribute to N pollution), air quality (high uncertainty).
      iv. Another important component of green roof construction is the life cycle assessment: green roofs typically last longer and thus produce less waste than conventional roofs.
      v. Arthropods also use green roofs – mobile species find them especially useful (increases connectivity). Even rare species have been found colonizing green roofs (e.g. London).
   b. Gardening/ Landscaping – gardens are important for biodiversity.
   c. Nesting structures – bat roosts, bird boxes, bee nests etc. can provide important habitat for animal diversity.
   d. Living walls – Much like green roofs, provide habitat for many species. In Hong Kong (at least) 1275 trees (>1m) and 30 spp (mostly native).
   e. Swales/ rain gardens – vegetated areas that cause rain collection and promote infiltration and evapotranspiration. They’ve also been shown to be effective in reducing water pollution.
   f. Permeable pavement can reduce runoff and therefore water pollution as well as providing possibilities for plant and tree life.
   g. Set-aside areas (mature trees) – tree preservation and planting can be an effective green-planning technique.