

Setting Reference Conditions and Restoration Goals in Urban Rivers: Balancing Ecological and Human Objectives

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Urban rivers are increasingly subject to restoration schemes, which seek to bring 'nature into the city' and often serve to promote economic and social revival of older urban districts. Per linear meter, these projects are often more costly than rural projects, and the ecological potential of such urban sites will inevitably be limited by the pressure of urban development encroached upon the banks and floodplain, and by the altered runoff from urbanized catchments. Thus, the interventions must generally be justified on social and economic benefits. In some cases, urban river projects actually make the river less 'natural' than before intervention, raising interesting questions about how such projects should be viewed under the WFD, and how the notion of reference conditions can apply in such thoroughly-altered environments. To stimulate thought on these issues, we present two contrasting examples of urban river rehabilitation projects, both representative of large classes of similar projects in the EU & US.

The Reno Whitewater Park on the Truckee River creates standing waves for kayakers at spring flows, and creates wading and paddling habitat for toddlers and children at summer baseflows. It is used for a popular, national kayaking competition annually, and receives constant, heavy use in summer months by families from nearby, low-income neighborhoods underserved by public parks. Wildlife agencies have expressed concerns about loss of fish habitat resulting from simplification of bank complexity and removing of overhanging riparian vegetation (for public safety and access).

The Polis project in Coimbra, Portugal, dammed the Mondego River to create an artificial lake, along which a park featuring a manicured lawn and café tables was constructed. Early in the 20th century, this urban reach of the Mondego was a popular wading spot for urban residents, but the deeper water created by the lake and the algal blooms that now occur in the dammed river preclude such uses today. These historical instream uses have been replaced by on-bank café and lawn activities. Ecologically, the project transformed formerly lotic into lentic habitats, eliminating conditions to which native fish were adapted, in effect imposing a landscape ideal onto a naturally variable Mediterranean-climate river.

Two Examples of Urban River Designs and Ecological Considerations

1. Reno Whitewater Park in Nevada, U.S.

Whitewater parks are a recent type of urban river design with man-made structures built in the river to create standing waves and hydraulics for kayaking and other forms of recreation. There are roughly ninety whitewater parks and courses around the world. The Reno Whitewater Park, built in 1997, is the longest in the U.S.



2. Polis Project in Coimbra, Portugal

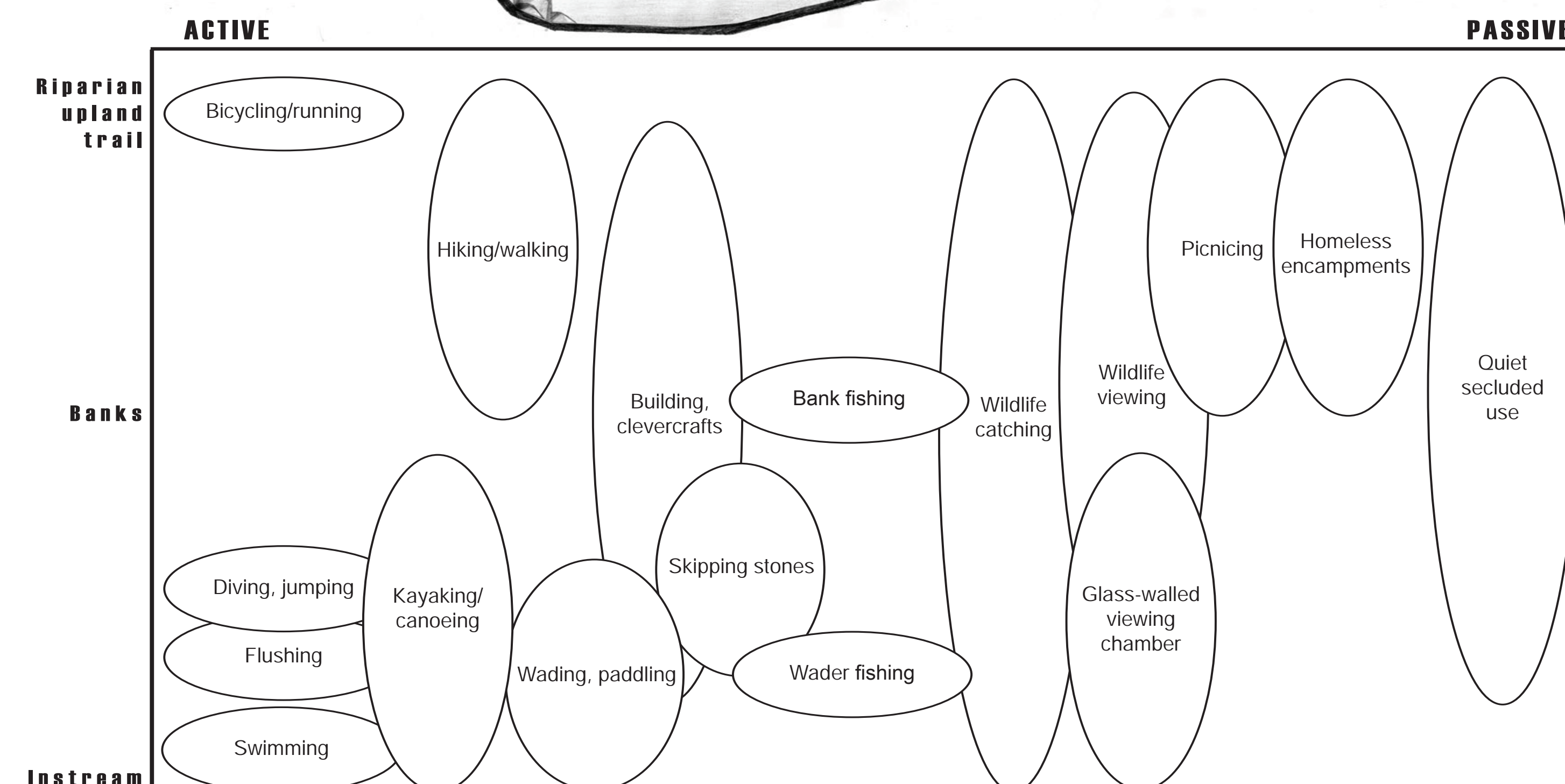
Portugal initiated the Polis Programme to improve urban environments (Partidário and Correia, 2004). Seventeen of the twenty-eight cities initially selected focused on river interventions. At Coimbra the Mondego River river was dammed and a large park constructed along the bank.



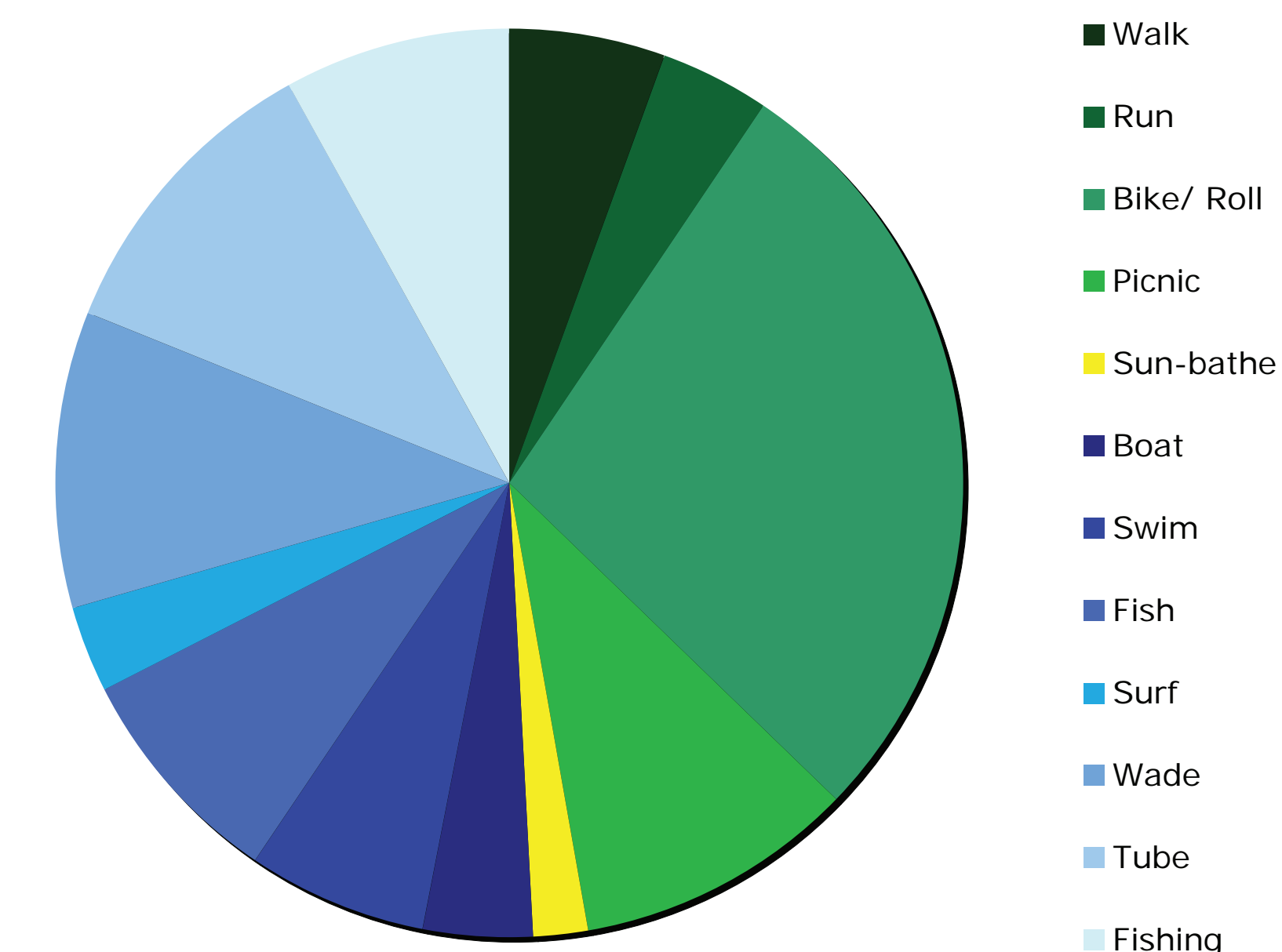
Wilderness-Urban Continuum of Restoration

	WILDERNESS	Transitional cases.	HIGHLY URBAN
Attributes	Unaltered watershed. Channel may be altered.		Highly altered watershed and channel. Encroached banks.
General approach	Can restore pre-disturbance, historical channel, by either: 1) letting river restore itself 2) 'carbon-copy' approach	Can partly restore processes. Must decide what changes to accept as constraints, what to try to change/restore.	Cannot restore historical conditions. Restoration as 'gardening': choose elements to include but must account for erosive forces, altered hydrology. Social issues are important: potential to improve ecology/water quality are limited, so emphasis on community-building and environmental education.
Examples	Flow regime unchanged. Sediment load unchanged. No urban encroachment.	Increase releases from dam? Reduce peak urban flow by detention? Add gravel below dams? Reduce erosion in watershed? Remove houses along bank/floodplain?	Flow regime altered. Sediment load altered. Urban encroachment to banks.

Range of Human Uses

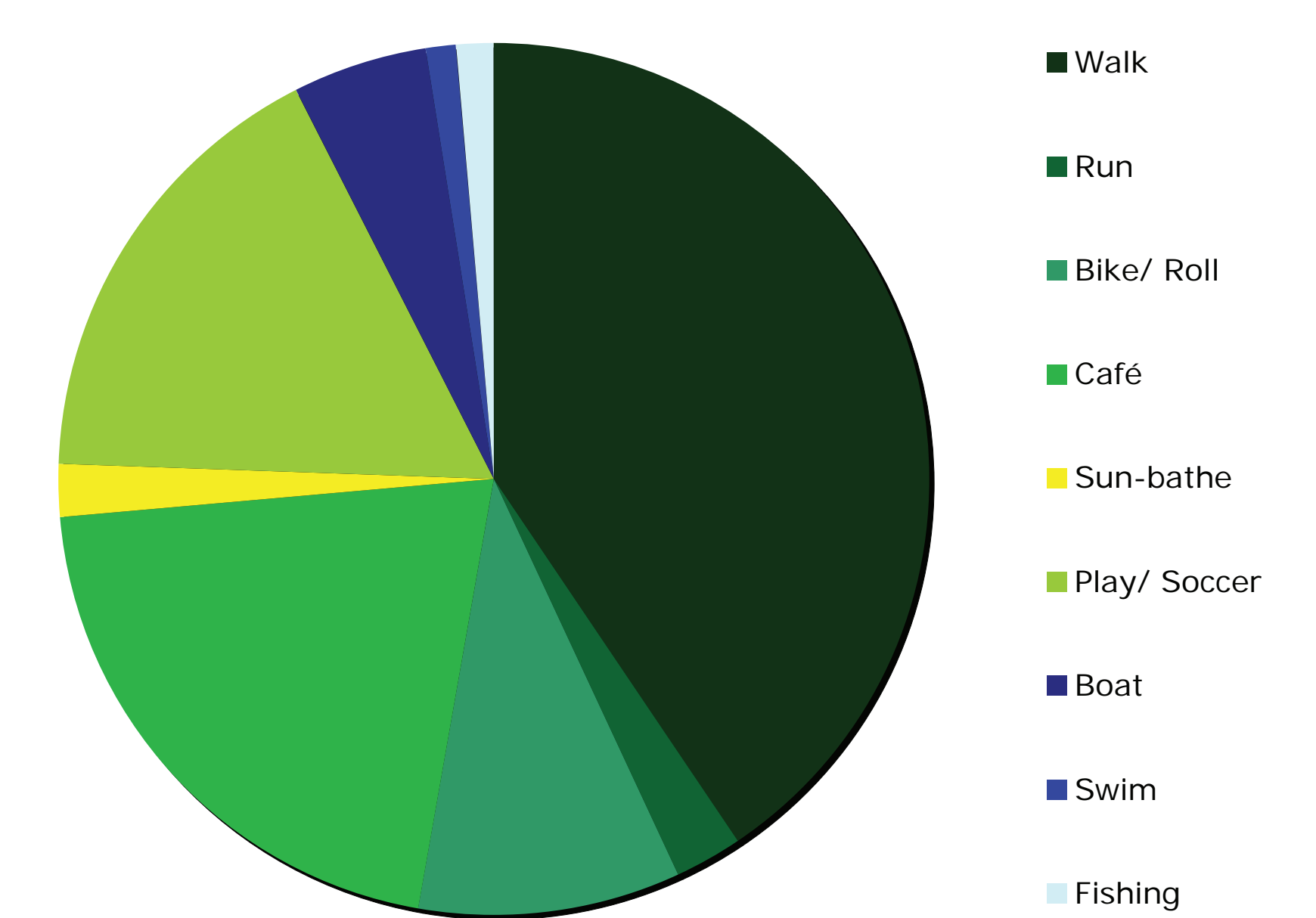


In-channel uses > On the bank uses



Data from use observations on the Truckee River, August 2008. Sixty five-people were interviewed. 71% of users are within 5 miles of the whitewater park, 45% visit more than once a week in the summer. 26% of the users have a median family income of \$20,000-40,000/year.

On the bank uses >>> In-channel uses



Data from use observations on the Rio Mondego, July 2008. About one thousand people were observed over two weekdays and one weekend.

Shifts from limited to easy river access



- Design Characteristics:**
- U-shaped structures create waves/holes
 - Anchored below scour or in bedrock
 - Boulders form mid-channel eddies
 - Terraced banks allow easy access
 - Riparian vegetation is modified
 - Can include 'In-Channel Recreational Diversions' in the state of Colorado only

Trade-Offs: Ecology vs. Human Use

- Fish Passage -Agency concerns, but deemed ok
- Overhanging banks modified to allow easy and safe human access
- Riparian vegetation modified, lack of bank cover
- Instream uses displace fish and other species
- "Nature in the city"
- Increased recreational opportunities for underserved population
- Conflicts among human uses (kayaking vs. toddler wading)

Shifts in Human Use Over Time



Today
Uniform Water Depth
No people wading or swimming



1940s
Low-Flow Late Summer
Past human uses in-channel

- Shift from Lentic ----> Lotic Aquatic Ecosystem (Mediterranean climate river character replaced by permanent water body)
- Fish Passage impaired
- Eutrophication, algal blooms
- Improved river bank and creation of a park
- More water in the summer may act to cool the local micro-climate?
- Less human use may ironically lower contact with potentially polluted river water

How do you set reference conditions in urban rivers?