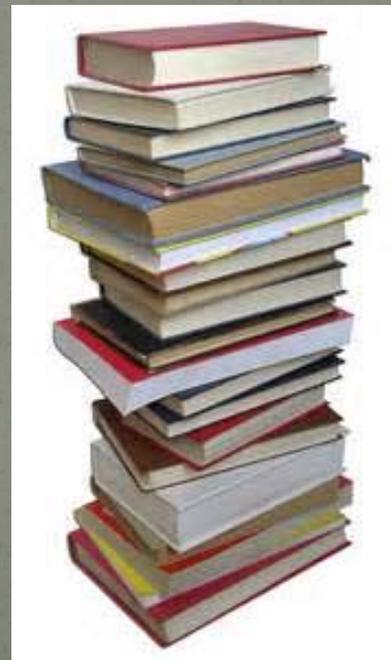


A photograph of a lush green grass field at dusk or dawn. The sky is dark, and numerous small, glowing white insects, likely fireflies, are scattered throughout the air, creating a magical atmosphere. The grass is tall and vibrant green, with some blades in sharp focus in the foreground.

# Food Base Enhancement



# It is well established that rainbow trout and native fish populations in Glen and Grand Canyon are limited by the availability of high quality invertebrate prey

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## Ecosystem ecology meets adaptive management: food web response to a controlled flood on the Colorado River, Glen Canyon

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## Observations of size-related asymmetries in diet and energy intake of rainbow trout in a regulated river

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**Key words:** food habits, Colorado River, dam tailwater, Arizona, *Oncorhynchus mykiss*



## Native and Nonnative Fish Populations of the Colorado River are Food Limited—Evidence from New Food Web Analyses

**F**ish populations in the Colorado River downstream from Glen Canyon Dam appear to be limited by the availability of high-quality invertebrate prey. Midge and blackfly production is low and nonnative rainbow trout in Glen Canyon and native fishes in Grand Canyon consume virtually all of the midge and blackfly biomass that is produced annually. In Glen Canyon, the invertebrate assemblage is dominated by nonnative New Zealand mudsnails, the food web has a simple structure, and transfers of energy from the base of the web (algae) to the top of the web (rainbow trout) are inefficient. The food webs in Grand Canyon are more complex relative to Glen Canyon, because, on average, each species in the web is involved in more interactions and feeding connections. Based on theory and on studies from other ecosystems, the structure and organization of Grand Canyon food webs should make them more stable and less susceptible to large



As one of the most carefully managed river systems in the world, the aquatic ecosystem of the Colorado River in the Grand Canyon has been heavily influenced by Glen Canyon Dam and the decades of controlled release of water for power generation. Photo by Robert O. Hall, Jr., used with permission.

*Ecological Monographs*, 83(3), 2013, pp. 311–337  
© 2013 by the Ecological Society of America

## Food-web dynamics in a large river discontinuum

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### Slide 3

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KT2

The foodbase project from 2006-2009 investigated sites throughout the CRE and came to basically the same conclusions that McKinney and Spears (2001) arrived at for rainbow trout in Glen Canyon....fish populations are limited by the availability of high quality invertebrate prey.

Kennedy, Theodore, 1/8/2014

The scientists have provided us with a wealth of basic research on food base:

- Types currently available
- Their densities
- Drift
- Impact of seasonal light variations
- Aquatic vegetation, etc

It is time to move to an applied management mode to improve the health of the invertebrate assemblage

Slide 4

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KT8

modified and shortened text

Kennedy, Theodore, 1/8/2014

A FY15-16 Food Base Enhancement project would include but not be limited to some of the following elements:

- ❖ A review of the data collected in the Tail Water Synthesis project
- ❖ Determine what flow regimes are most positive to higher densities of aquatic invertebrates
- ❖ Translocation of native insect taxa from other segments of the Colorado River
- ❖ Habitat augmentation to improve colonization and establishment of host colonies of invertebrates.

Slide 5

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KT6

shortened text. The points you were making were all  
Kennedy, Theodore, 1/8/2014

A project of Food Base Enhancement would support a number of the Desired Future Conditions:

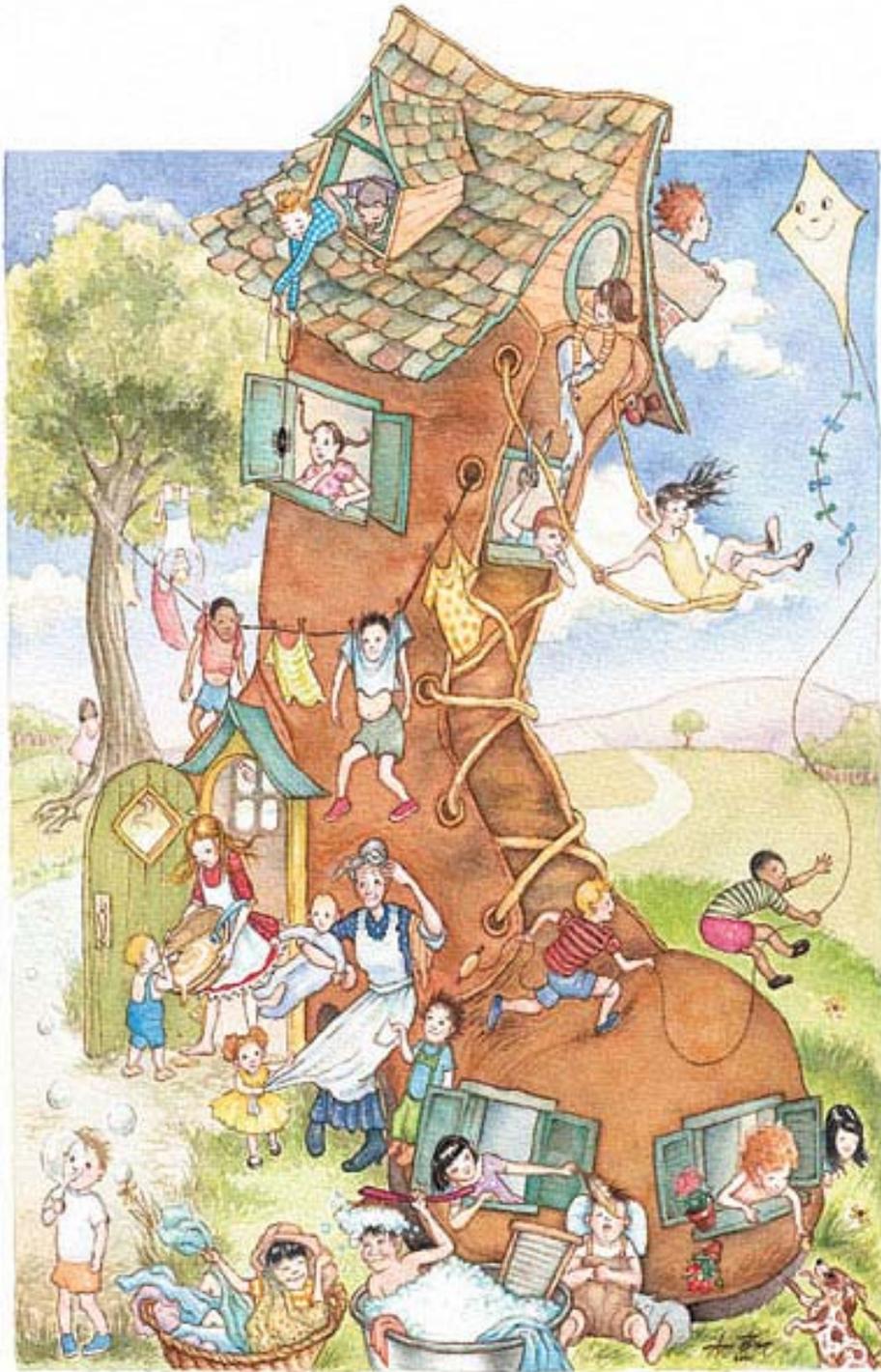
**CRE Aquatic Domain**

*Native Species*

*Rainbow trout*

*Nonfish Biotic Communities*

**Blue Ribbon Trout Fishery in Glen Canyon  
National Recreation Area**



**The problem** is that we have, in most all areas of the River, too many children (total fish of all species).



OLD MOTHER HUBBARD

Which has resulted in Mother Hubbard's cupboard being bare!

The answer is not to kill the children!