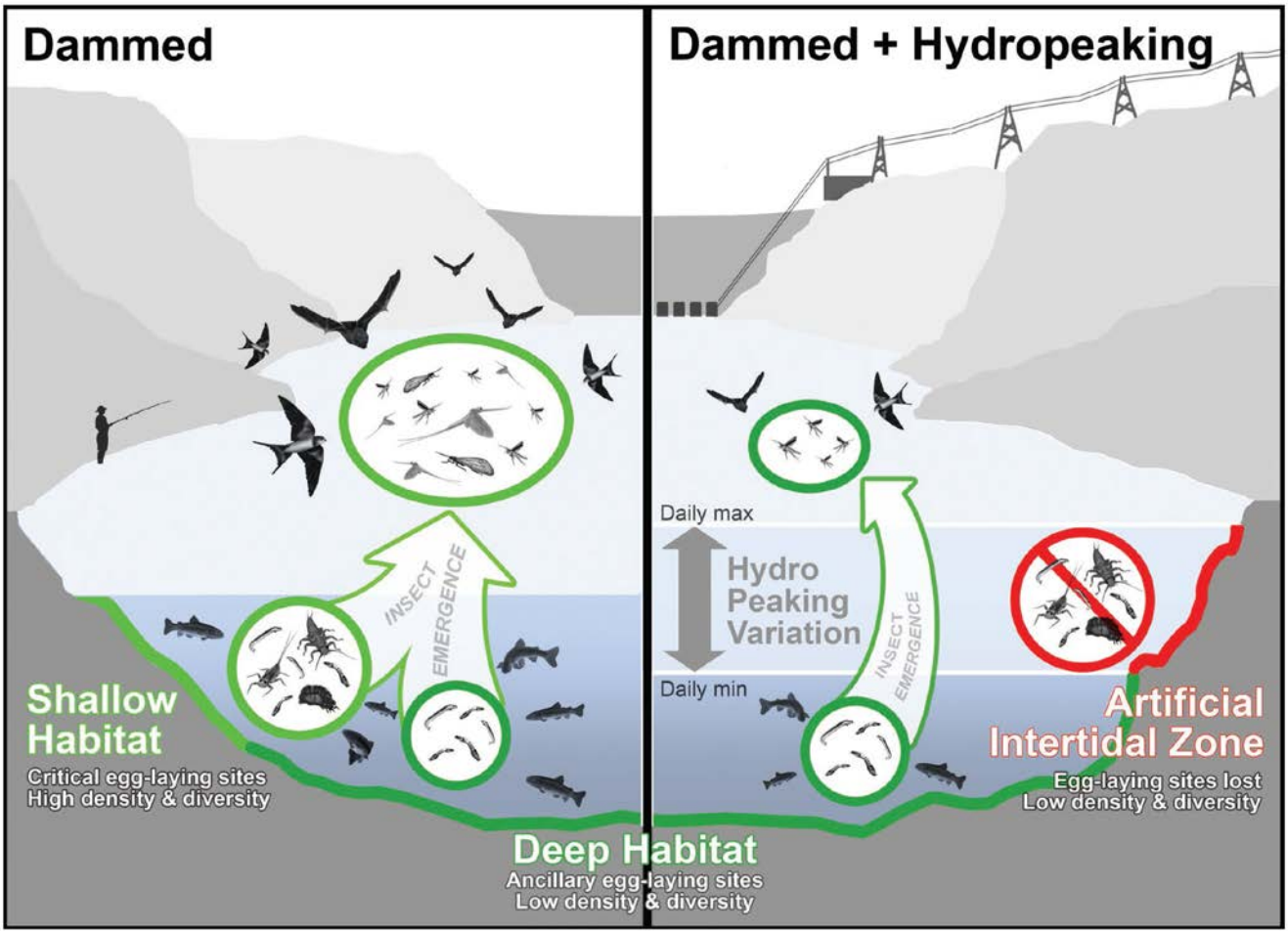
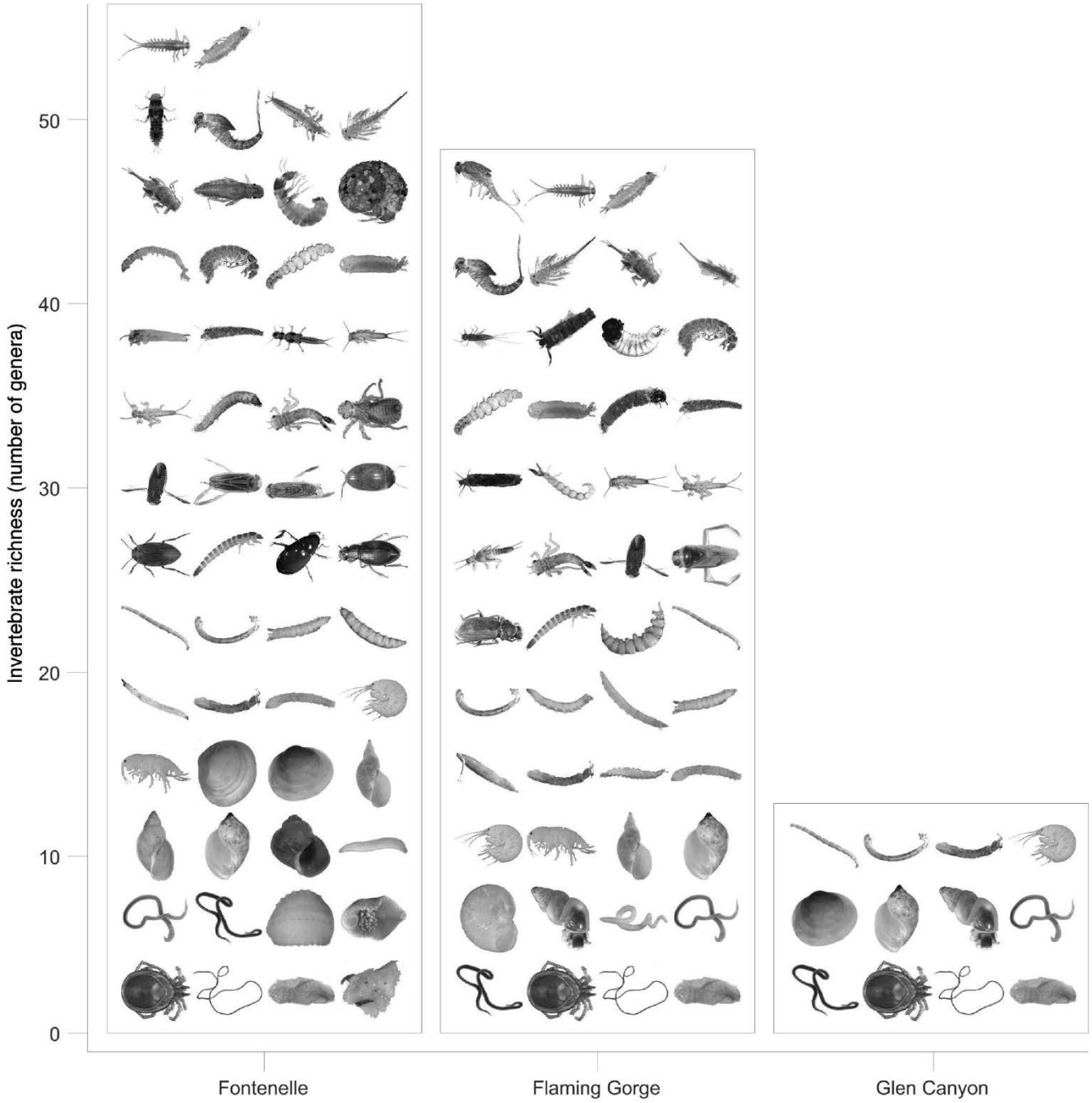
Presenter: Ted Kennedy, US Geological Survey, Grand Canyon Monitoring and Research Center
Title: Little bugs, big data, and Colorado River adaptive management

Summary: Dams impound the majority of the world's rivers and provide important societal benefits, including daily water releases that enable on-peak hydroelectricity generation. Such "hydropeaking" is common worldwide, but its impact on downstream ecosystems is poorly understood. We evaluated the response of aquatic insects, the foundation of river and riparian food webs, to hydropeaking using an aquatic insect life history–hydrodynamic model. This model predicts that aquatic-insect abundance in hydropeaking rivers will depend on a basic life-history trait—the egg-laying behavior of the terrestrial adult life stage—such that species with open-water egg laying behaviors will be unaffected by hydropeaking, whereas ecologically important species such as mayflies, which lay their eggs along river margins, will be extirpated from hydropeaking rivers. These predictions are supported by a more-than-2500-sample, citizen-science data set of aquatic insects from the Colorado River in the Grand Canyon collected almost entirely by professional river guides and by a survey of insect diversity and hydropeaking intensity across dammed rivers of the Western United States. Our study reveals that hydropeaking creates a life history bottleneck that prevents viable populations of many aquatic insect species from inhabiting regulated rivers. Conclusions from this study informed the design of experimental macroinvertebrate production flow (aka bug flows), which will be tested as part of implementation of the LTEMP-EIS selected alternative for operation of Glen Canyon Dam.



Aquatic insects play an essential role in river and riparian food webs. Aquatic insects are ubiquitous in freshwaters and are the primary prey for myriad species of wildlife living in and along rivers. These insects have complex life cycles that include a terrestrial winged adult life stage, whereas egg, larval, and pupal stages are aquatic. Ecologically important insect groups such as mayflies, stoneflies, and caddisflies cement their eggs along river margins, making them especially sensitive to dam water management practices such as hydropeaking that affect these edge habitats (adapted from Kennedy and others, 2016, Bioscience).



A photo collage showing genus-level invertebrate richness for three well-studied Western US rivers. The Green River below Fontenelle Dam (left) does not hydropeak (average daily change in river height of 0.1 feet), and invertebrate assemblages there include 54 unique genera, including many aquatic insects. The Green River below Flaming Gorge Dam (center) has a moderate intensity of hydropeaking (average daily change in river height of ~0.9 feet) and contains 47 unique invertebrate genera. The Colorado River below the Glen Canyon Dam (right) has a high degree of hydropeaking (average daily change in river height of ~1.9 feet) and supports only 12 unique invertebrate genera, most of which are non-insects such as snails and worms (adapted from Kennedy and others, 2016, Bioscience).