# Developing tools for landscape-scale restoration in the Delta Erin Beller\*, Sam Safran, Robin Grossinger, Letitia Grenier, Alison Whipple, Julie Beagle, April Robinson, Ruth Askevold \*\*Contact author: erin@sfei.org; SFEI, 4911 Central Ave, Richmond, CA 94804



Emerging strategies to improve the ecological health of the Delta emphasize a landscape-scale approach to restoration (BDCP 2012, Delta Plan 2012). However, few tools are available that illuminate what large, interconnected habitat restoration should look like for the region, or how to design projects that successfully provide desired ecological functions.

Management Tools for Landscape-Scale Restoration of Ecological Functions in the Delta is a new Ecosystem Restoration Program-funded project (begun February 2012) designed to contribute this needed dimension to Delta planning. The project will build on the detailed understanding of former (early 1800s) ecological patterns and underlying physical processes recently published by Whipple et al. (2012) to help establish a regional vision for landscape-scale res-

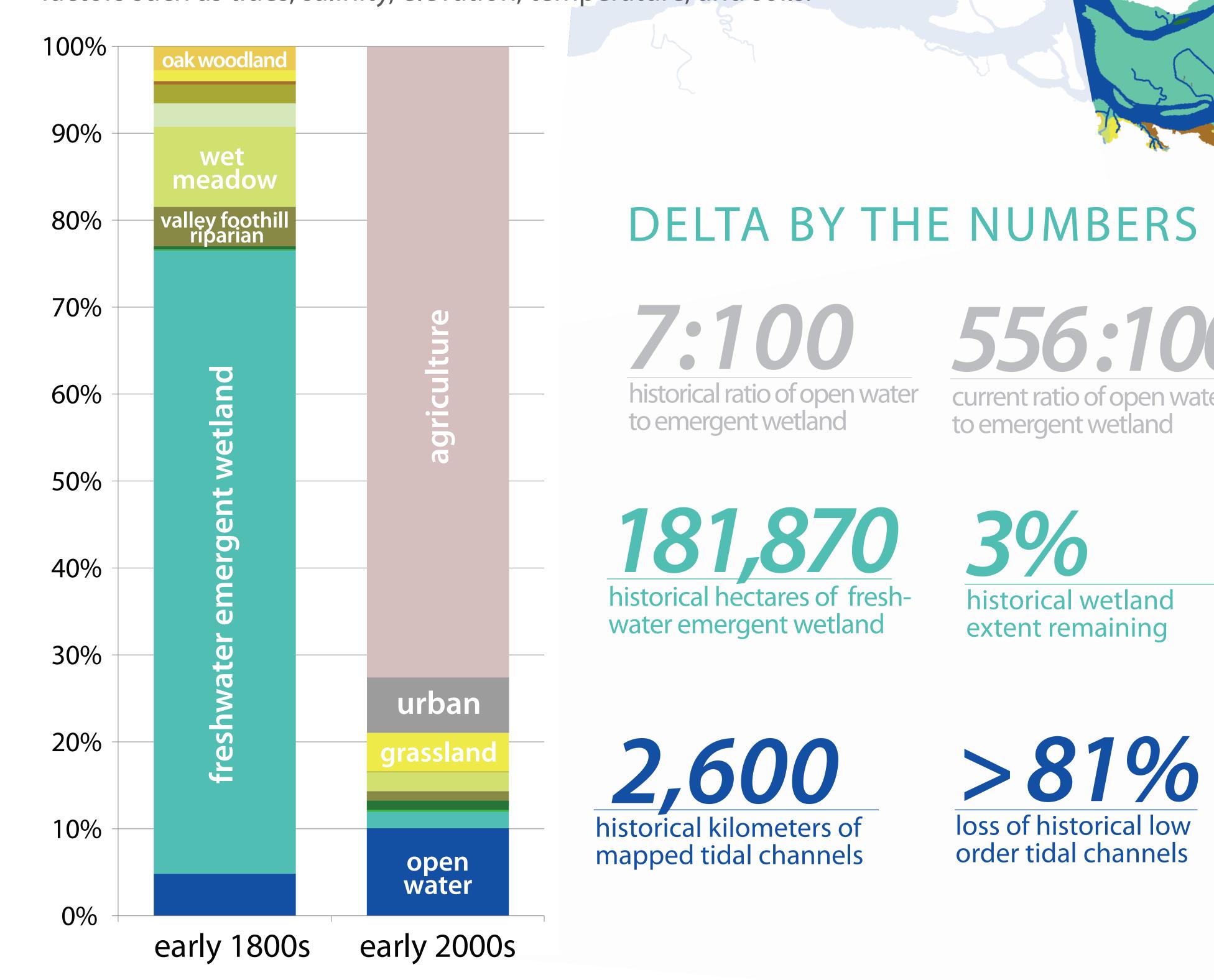
With a team of experts in ecology and physical process, we are integrating this depiction of the historical landscape with contemporary knowledge to define the array of ecological functions formerly provided different regions of the Delta. Suites of metrics representing each function will be quantified, then examined in the context of the Delta's broader physical settings. These key functions and metrics will be used to develop conceptual models of landscape-scale function that can be applied to identify areas in the current Delta where similar functions might be reestablished and maintained.

channel alignment

This understanding of Delta landscapes past, present, and future can help managers and scientists develop practical and effective landscape restoration strategies that support desired ecological functions in the future.

### The Delta supported complex mosaics of habitats in the recent past.

The map at right illustrates landscape-scale patterns of habitat diversity in the historical Delta. These patterns reflected broad regional physical gradients in factors such as tides, salinity, elevation, temperature, and soils.

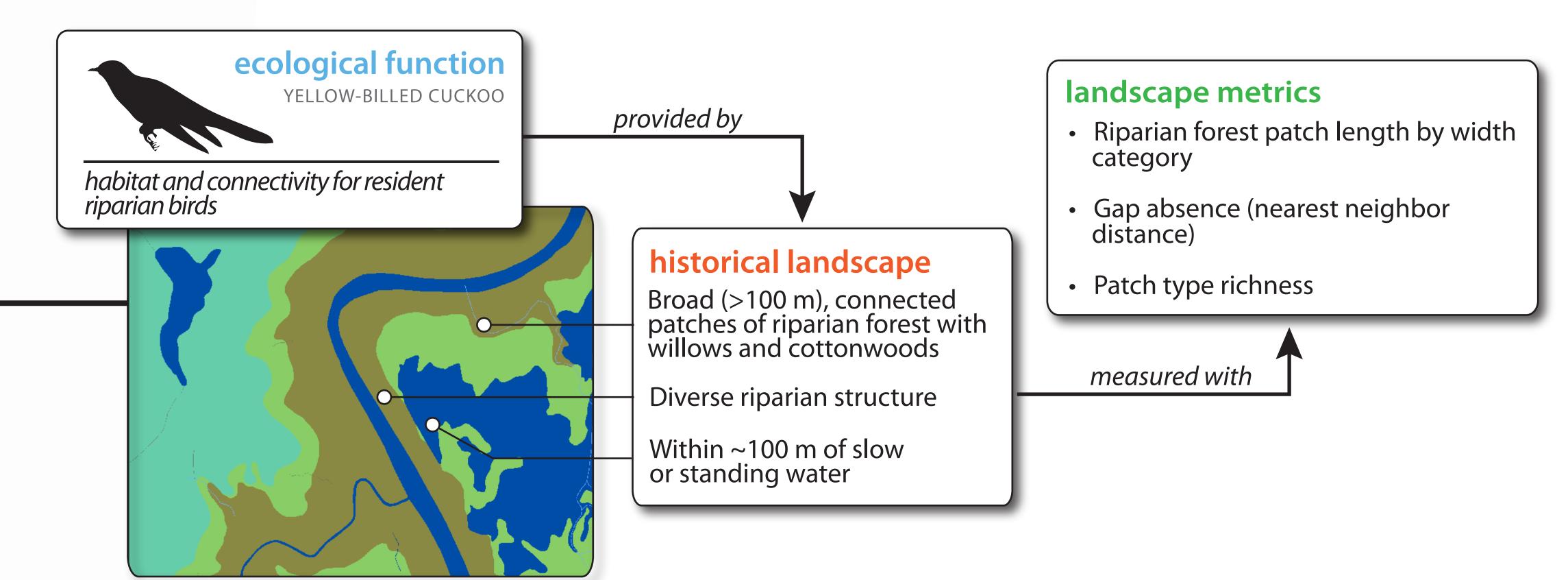


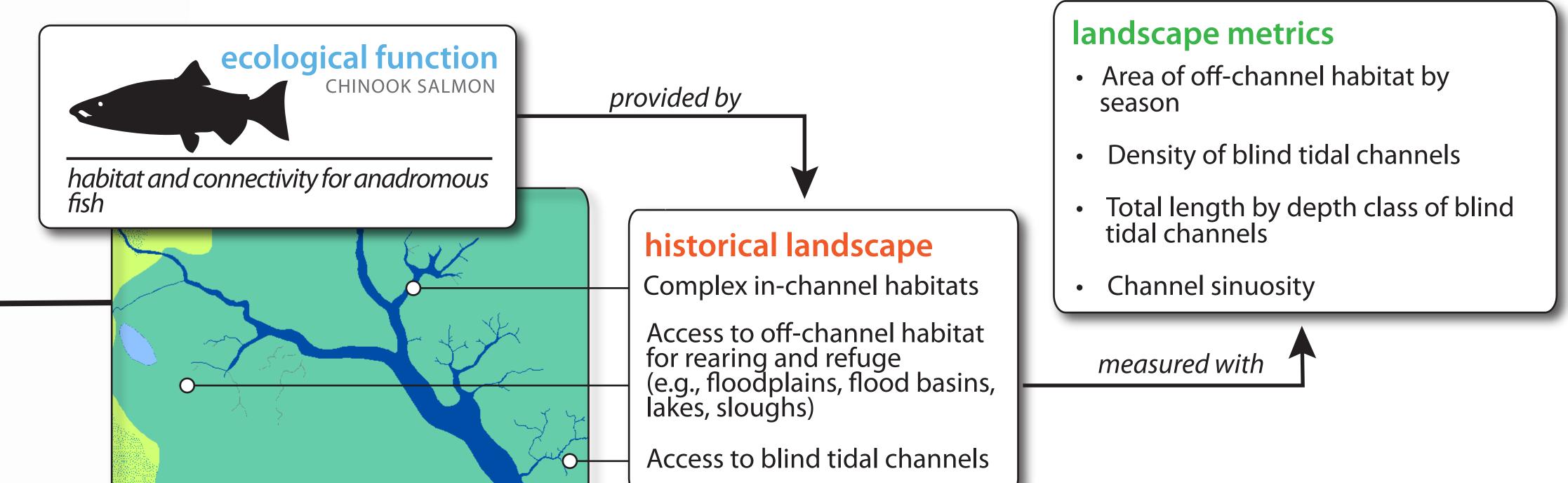
# What ecological functions did the Delta provide?

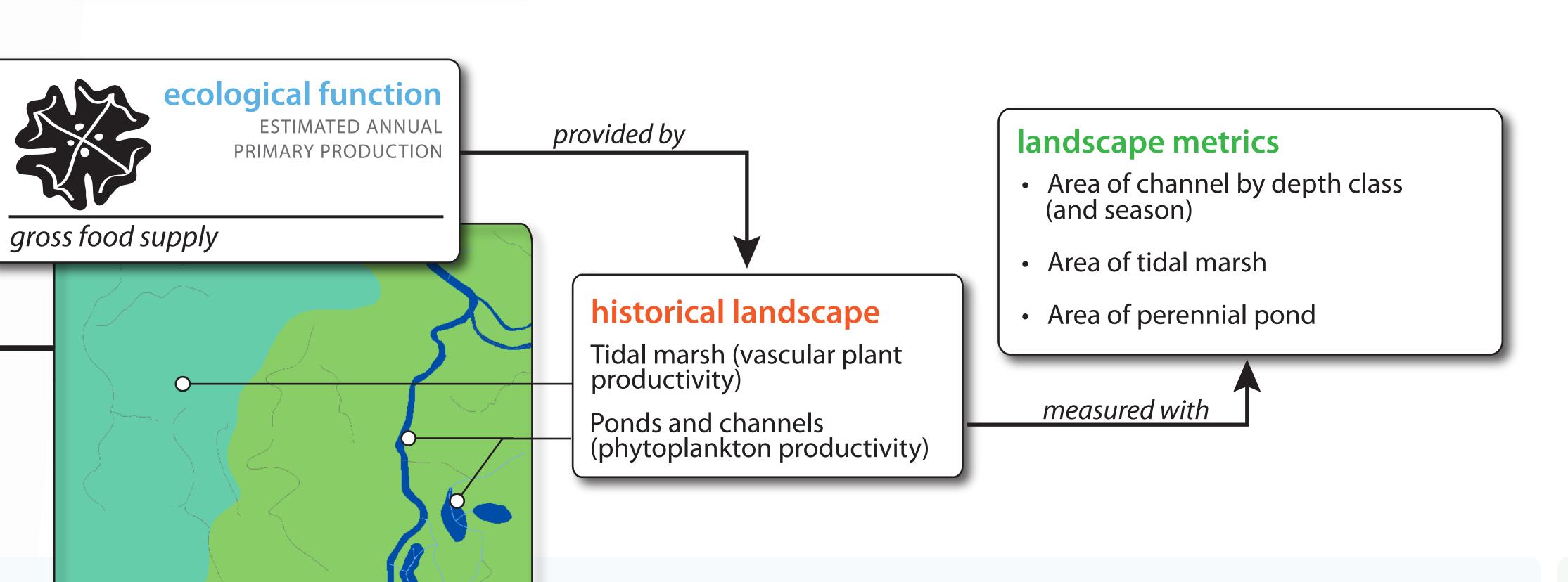
Through extensive discussions with contemporary experts, we have identified key ecological functions that would have collectively supported healthy, diverse wildlife communities in the Delta. Ecological functions to be addressed include population-level functions such as habitat and connectivity for native species and the maintenance of genetic and phenotypic variability, as well as community-level functions such as gross/net food supply and the maintenance of biodiversity.

# How do we measure and quantify these functions?

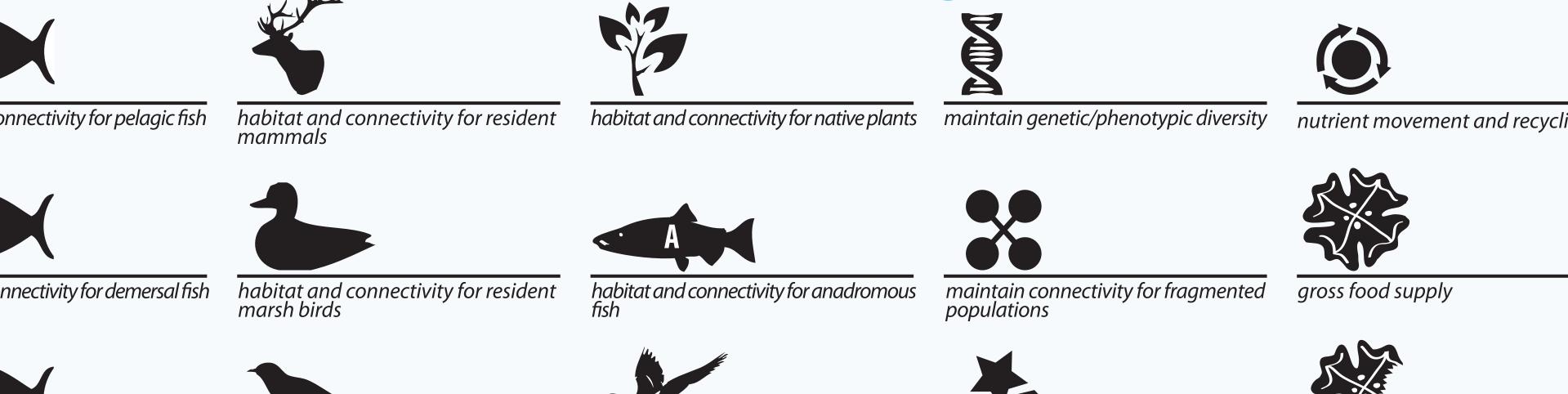
A suite of approximately twenty landscape metrics measuring aspects of the historical landscape will be used to assess the extent and distribution of these key ecological functions across the Delta. By extracting data from the historical mapping (at left) and associated historical sources, these metrics will allow us to quantify the extent and distribution of each function. Many metrics will also be applied to the contemporary Delta, allowing us to measure change over time.







# ecological functions list



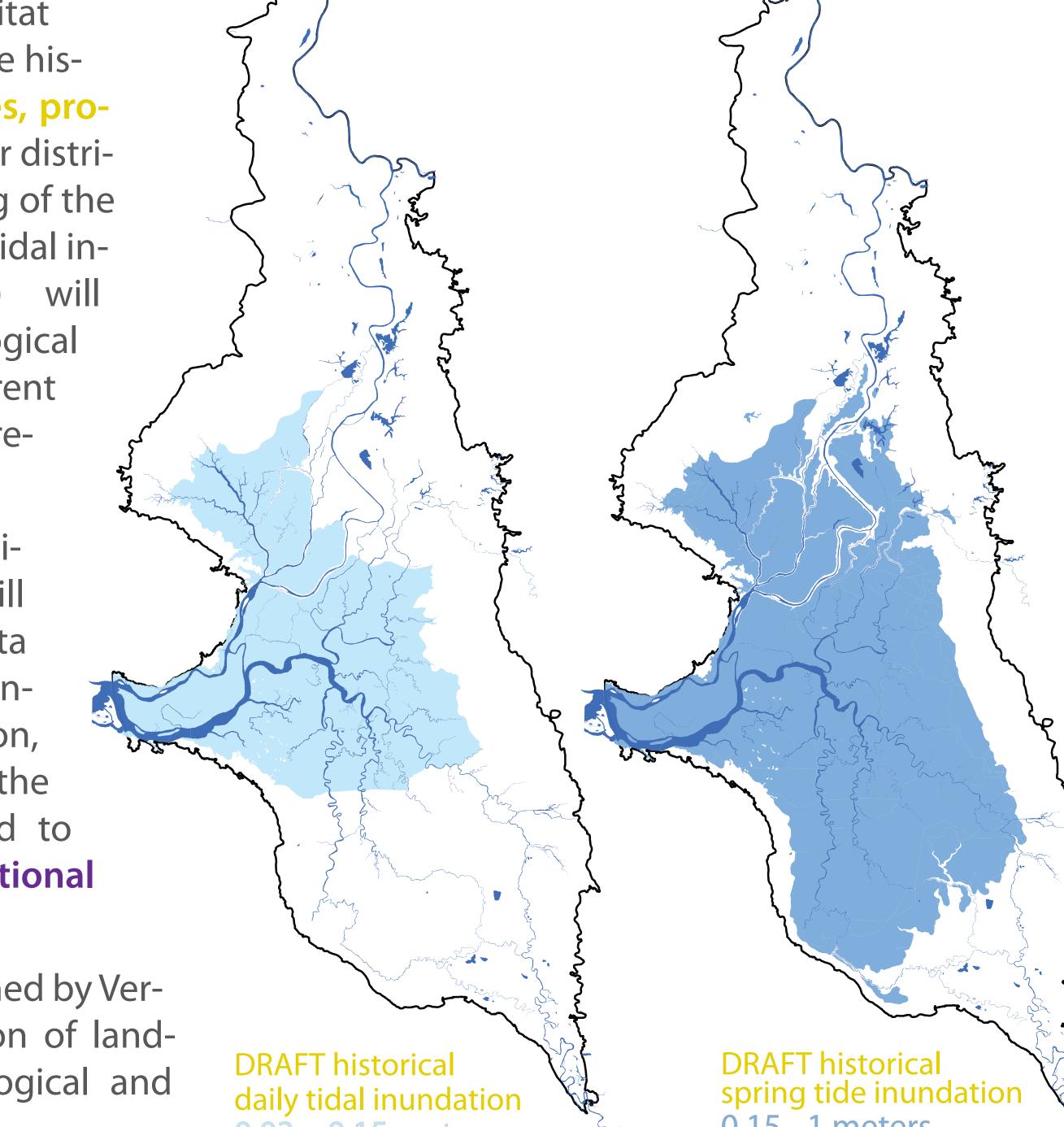
## What constituted a functional landscape?

This quantification of ecological functions offers a spatially explicit assessment of how functions were c tributed across the historical Delta. But understanding why these functions occurred where they did is just

We will relate the arrangement of habitat mosaics and ecological functions in the historical Delta to the physical structures, processes, and drivers that governed their distribution. For example, an understanding of the spatial extent and timing of historical tidal inundation across the Delta (at right) will inform our understanding of the ecological functions that are sustain ed by different inundation dynamics (such as depth, frequency, and timing).

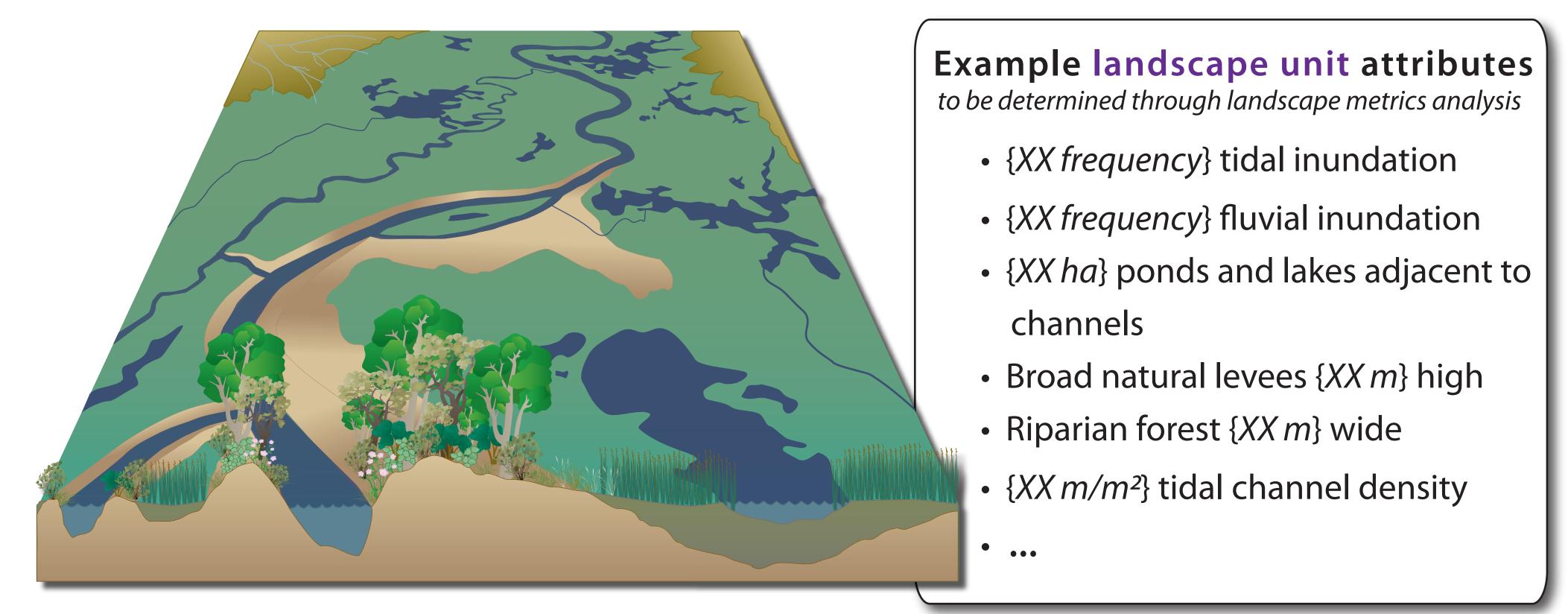
Taken together, maps of former ecological functions and physical processes will provide an understanding of how Delta landscapes were created and maintained over time, and by extension, where they might be restored in the future. This information will be used to identify several functional or operational landscape units in the historical Delta.

An "operational landscape unit" is defined by Verhoeven et al. (2008) as a "combination of landscape patches with their hydrogeological and biotic connections."



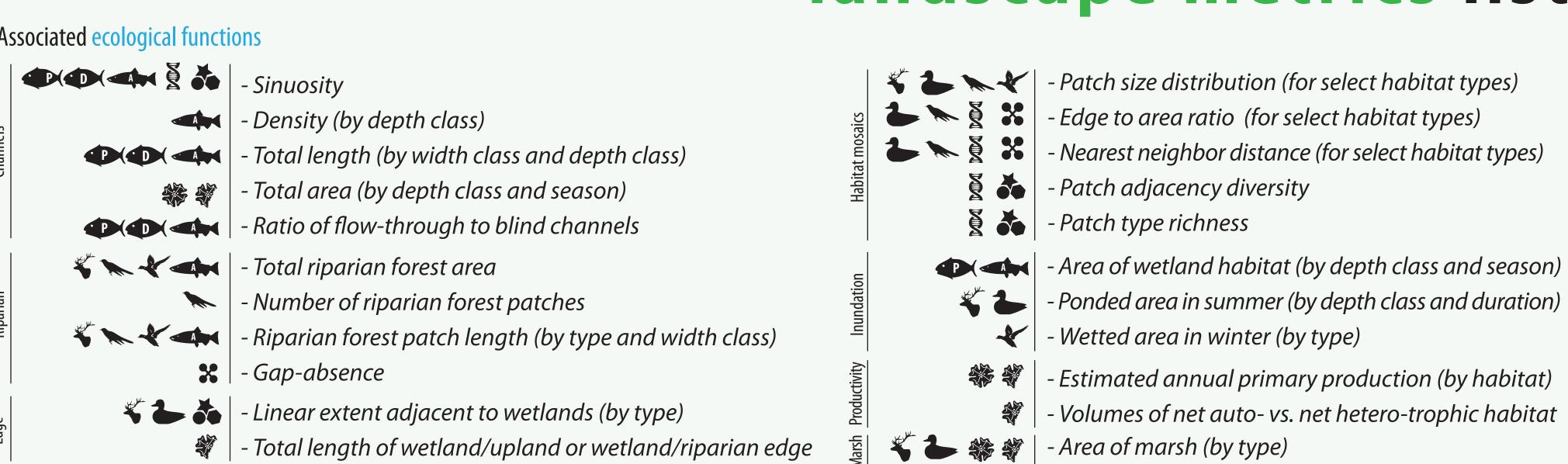
functional landscape

The Delta was composed of many such units, each dominated by different processes and supporting different ecological functions. Functional landscape units are a useful way to organize ecosystem function at a meaningful scale, where each element needed to sustain diverse, healthy populations of native species is present within the landscape. These landscape units will be used to help produce conceptual models that demonstrate the relationships between physical and ecological factors.



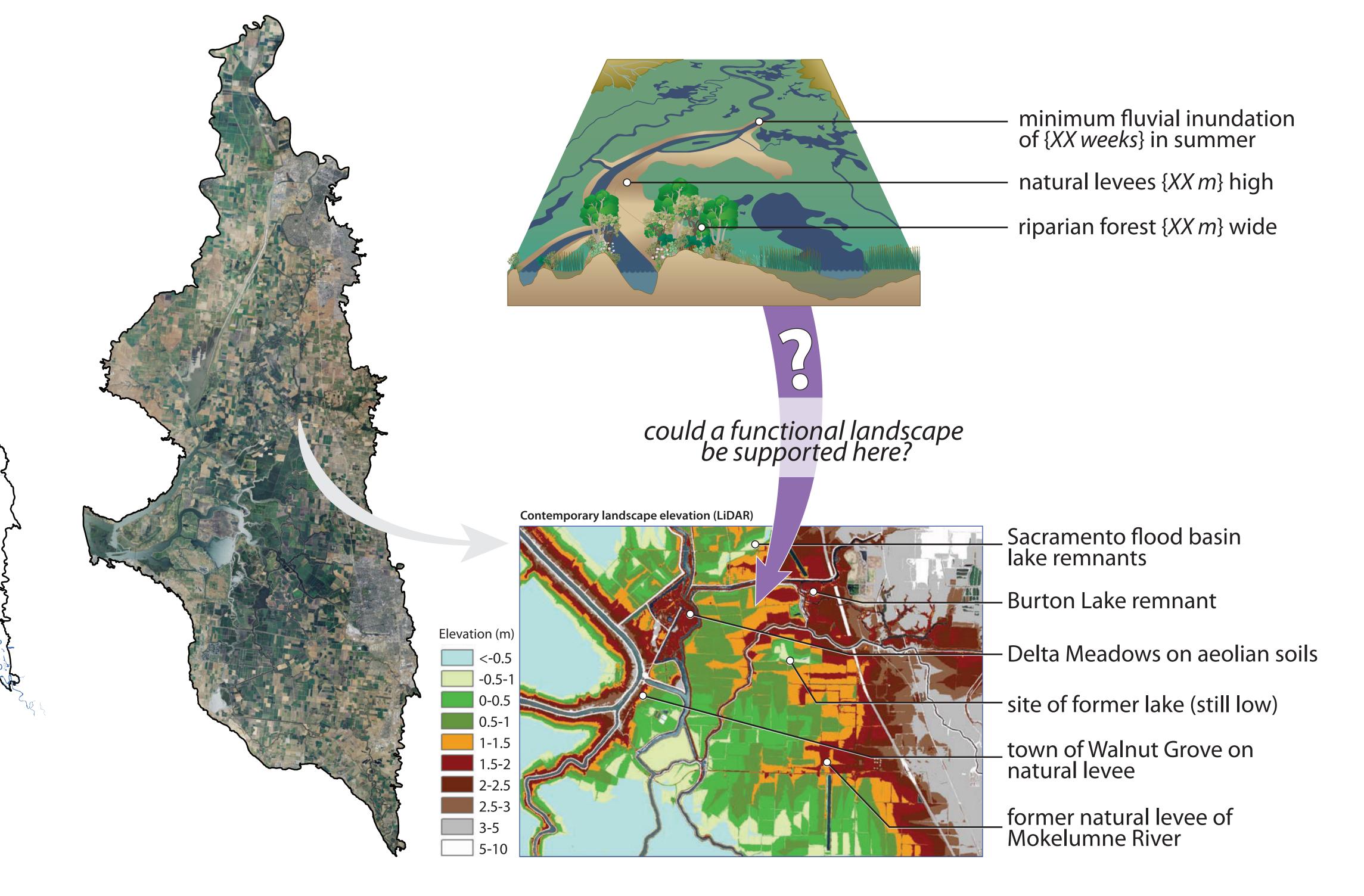
example functional landscape unit

### landscape metrics list



### Where could functional landscapes be supported today?

Functional landscape units provide a useful framework for examining how diverse, connected ecosystems operated in the recent past. The next step is applying that understanding to the contemporary landscape to evaluate what fundamental elements – both ecological and geophysical – are needed to support and maintain healthy landscapes today. How and where does the contemporary Delta provide these same ecological functions and sustain these hydrogeomorphic processes, and where does it have the potential to support them in the future? Conversely, which attributes are missing from the contemporary landscape?



### MANAGEMENT TOOLS FOR LANDSCAPE-SCALE RESTORATION

The Delta of the future will be very different from the Delta of the past. Yet we have much to learn from studying how past landscapes looked and worked. Landscapes will not necessarily be reestablished in the same places or at the same scale as they were historically. However, understanding the elements that created large, interconnected, diverse, and functional landscapes in the former Delta is a critical component of designing meaningful landscapescale restoration projects today.

We will develop tools that provide a spatially explicit perspective on restoration opportunities:

- Restoration design principles and guidelines - How will goals vary spatially across the Delta? How can projects be connected across the region - Recommendations and targets based or landscape metrics
- Delta, and where they may be constrained.

Rather than a template to rebuild the past, historical ecology contributes valuable information concerning how different elements within the future Delta might best fit together to support ecosystem health. These tools will help create functional landscapes that are more resilient to future change.

### time line



BDCP 2012. Bay Delta Conservation Plan Draft EIR/EIS. Available at http://baydeltaconservationplan.com/. Delta Plan 2012. Final Staff Draft Delta Plan. Available at http://deltacouncil.ca.gov/sites/default/files/documents/files/DeltaPlan\_05-14-2012.pdf Verhoeven JTA, Soons MB, Janssen R, et al. 2008. An Operational Landscape Unit approach for identifying key landscape connections in wetland

Whipple AA, Grossinger RM, Rankin D, et al. 2012. Sacramento-San Joaquin Delta historical ecology investigation: exploring pattern and process. SFEI Publication #672. San Francisco Estuary Institute-Aquatic Science Center, Richmond, CA.