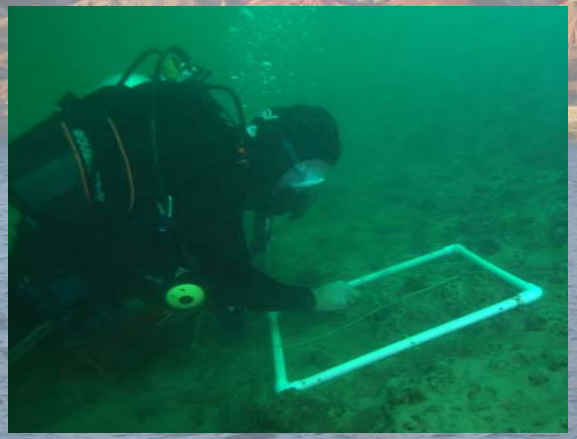
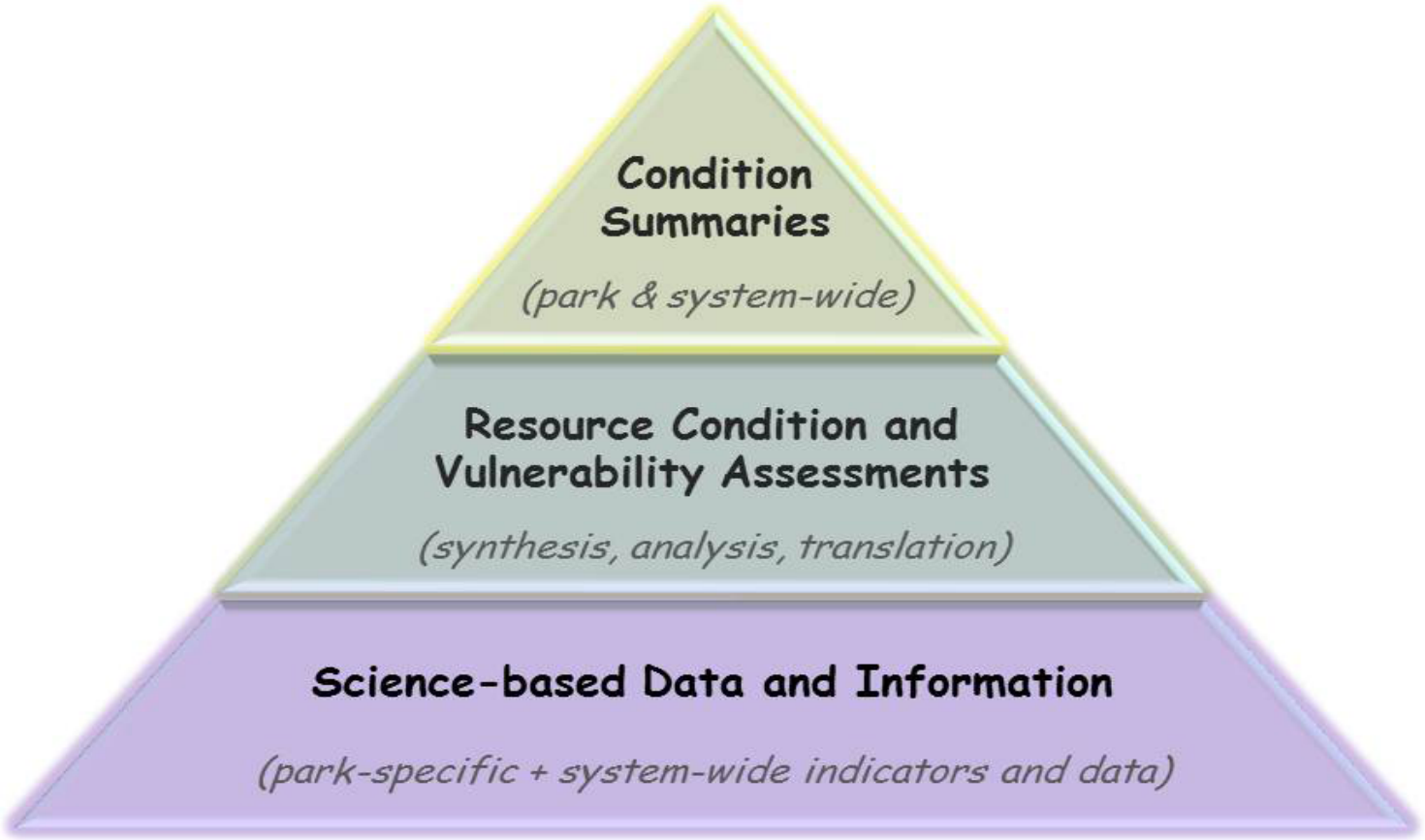
Partnership to Conduct Natural Resource Condition Assessment (NRCA) for Lakes Mead and Mohave

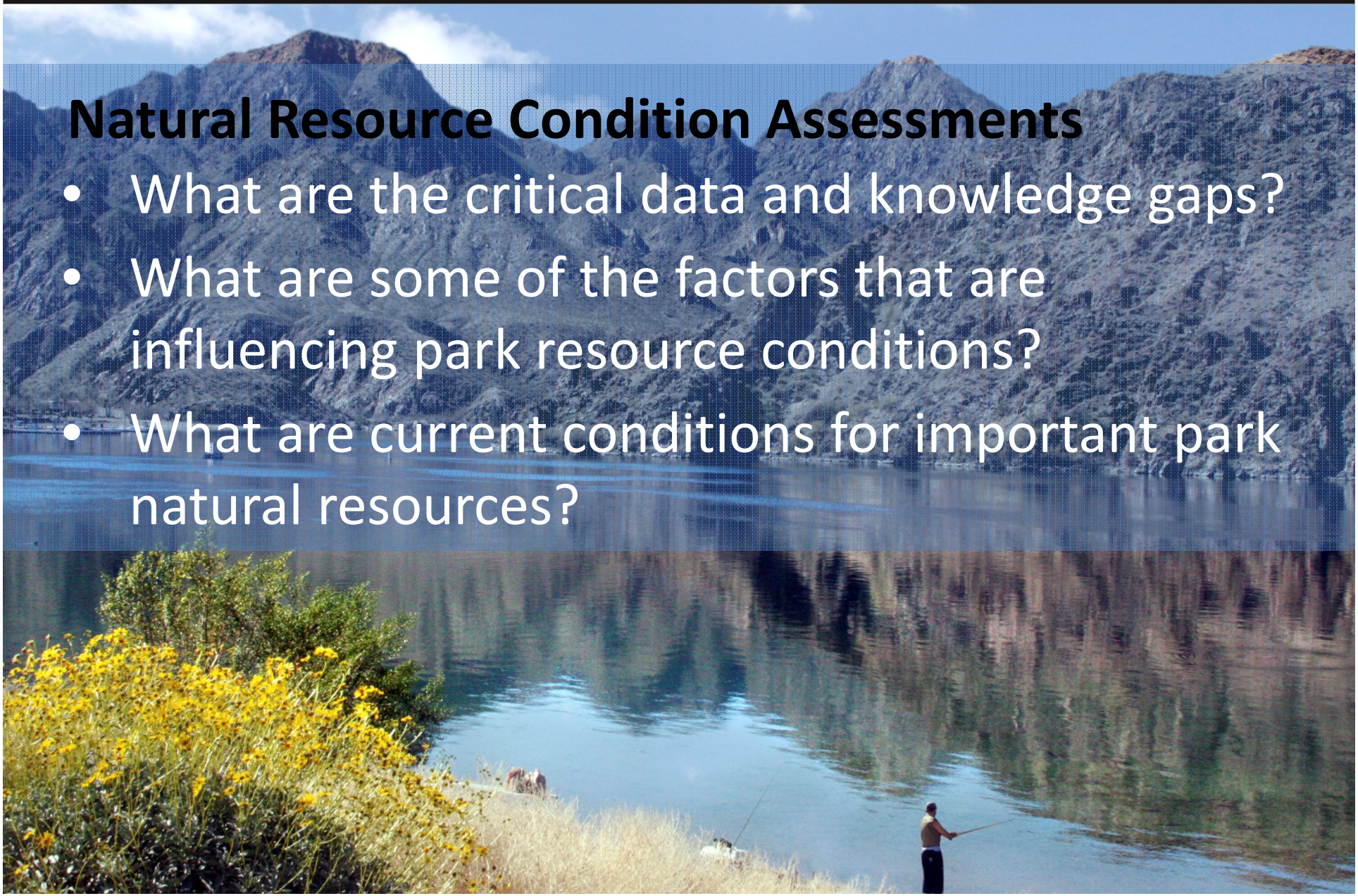


Kent Turner, Lake Mead National Recreation Area
Christine Ngai-Ryan & Sudeep Chandra, University of Nevada, Reno
February 8, 2016

NRCAs for approximately 270 units within the National Park System



A simplified view of credible resource condition reporting for national park units



Natural Resource Condition Assessments

- What are the critical data and knowledge gaps?
- What are some of the factors that are influencing park resource conditions?
- What are current conditions for important park natural resources?

Purpose of NRCA

To assist park managers in:

- Integrated (interdisciplinary) and strategic approach to resource planning
- Informed decision making
- Communication of current resource condition status to interested stakeholders and the general public

NRCA Approach

- Environmental framework: EPA: landscape condition, biotic condition, chemical and physical characteristics, ecological processes, hydrology and geomorphology, and disturbance regimes
- Identification of indicators for each of the six environmental framework attributes – 29 total indicators
- Scale of analysis for each indicator: e.g. basin, lakewide, watershed
- Review of existing data and literature for each indicator
- Documentation of status for each indicator, and thresholds, regulatorily or environimentally
- Condition status for each indicator, and holistically, by scale
- Identification of Gaps

Lake Mead NRCA Indicators

Indicator	Measurement	Metric	Scale of Analysis	Reference Condition	Data Source for Threshold
Landscape Condition					
Land Use Within Watershed	Land ownership and zoning adjacent lands	Acres/percent with NPS zone assignments: (1) Conservation (2) Developed (3) Undeveloped	Watershed; Basin	Degraded; not supporting; Good, supporting	Batker et al. 2014; USDOI 2014
	Active Land Uses	Acres active: (1) Development (2) Conservation (3) Recreation	Watershed; Basin		Batker et al. 2014; USDOI 2014
	Urbanized miles tributaries	(1) Acres/percent (2) NPDES discharges/no. of NPDES permits	Watershed; Basin		GIS analysis; Permit data from 4 dischargers
Aquatic system characterization	Lake Characteristics	(1) Inflow (2) Residence Time (3) Sedimentation	Lake	Relative to historical; Relative to EPA National Lake Assessment	Turner et al. 2010, USBR, USGS
	Stream Reach Characteristics	Temp, DO, pH, Conductivity, TN, Ortho P, NO3+NO2-N	Tributaries	Wastewater standards for streams entering park (Degraded or not degraded)	Holdren and Turner 2010 (USBR, USGS data)
	Recreational setting	Clarity, Viewshed	Watershed	Secchi relative to historical; viewshed	As available from NPS manageme nt docs

Lake Mead NRCA Indicators

Indicator	Measurement	Metric	Scale of Analysis	Reference Condition	Data Source for Threshold
Biotic Condition					
Native Fish	Population trends, by species	Species abundance, Population Estimate	Lake	Viability trend (increasing or decreasing)	(1) LCRMSCP 2014 (Bonytail, Razorback) (2) AGFD Reports (Need) (3) NDOW (4) USBR *Need list of Native Fish
Sportfish	Population trends by species, Angler Catch Rates	# species; pop estimates	Lake	10 year trends /catch rates	(1) AGFD Reports (2) Turner et al. 2010 (3) NDOW (Brandon Senger-trawl net data)
Forage Fish	Population trends threadfin shad; others	Abundance, Catch rates	Lake	10 year trends/ Catch rates	(1) NDOW (Brandon Senger--trawl net data) (2) Turner et al. 2010
Birds	Population trends by key shorebird species; guilds	# species; pop estimates	Lake	Averages/ Baseline 2004 - 2009	(1) Interagency effort under LCRMSCP and Clark County MSHCP (2) UNLV reports (3) USGS Circ 1381 (4) USDOI 2014
Invertebrates	Population trends by key taxonomic groups (Benthos)	Density benthic macroinvertebrates, springsnails	Lake	Changes in baseline 1980's-Present	(1) Wittmann et al. 2010 (2) USGS Circular 1381 (3) USDOI 2014
Benthic Organisms	See Invertebrates				
Zooplankton	Population trends by key taxonomic groups	Density	Lake	Changes in baseline	(1) SNWA-monthly data (2) USBR-quarterly data (3) USGS Circular 1381 (4) Turner et al. 2010
Phytoplankton	Population trends by key taxonomic groups	Density	Lake	Changes in baseline	(1) SNWA-monthly data (2) USBR-quarterly data (3) USGS Circular 1381 (4) Turner et al. 2010

Lake Mead NRCA Indicators

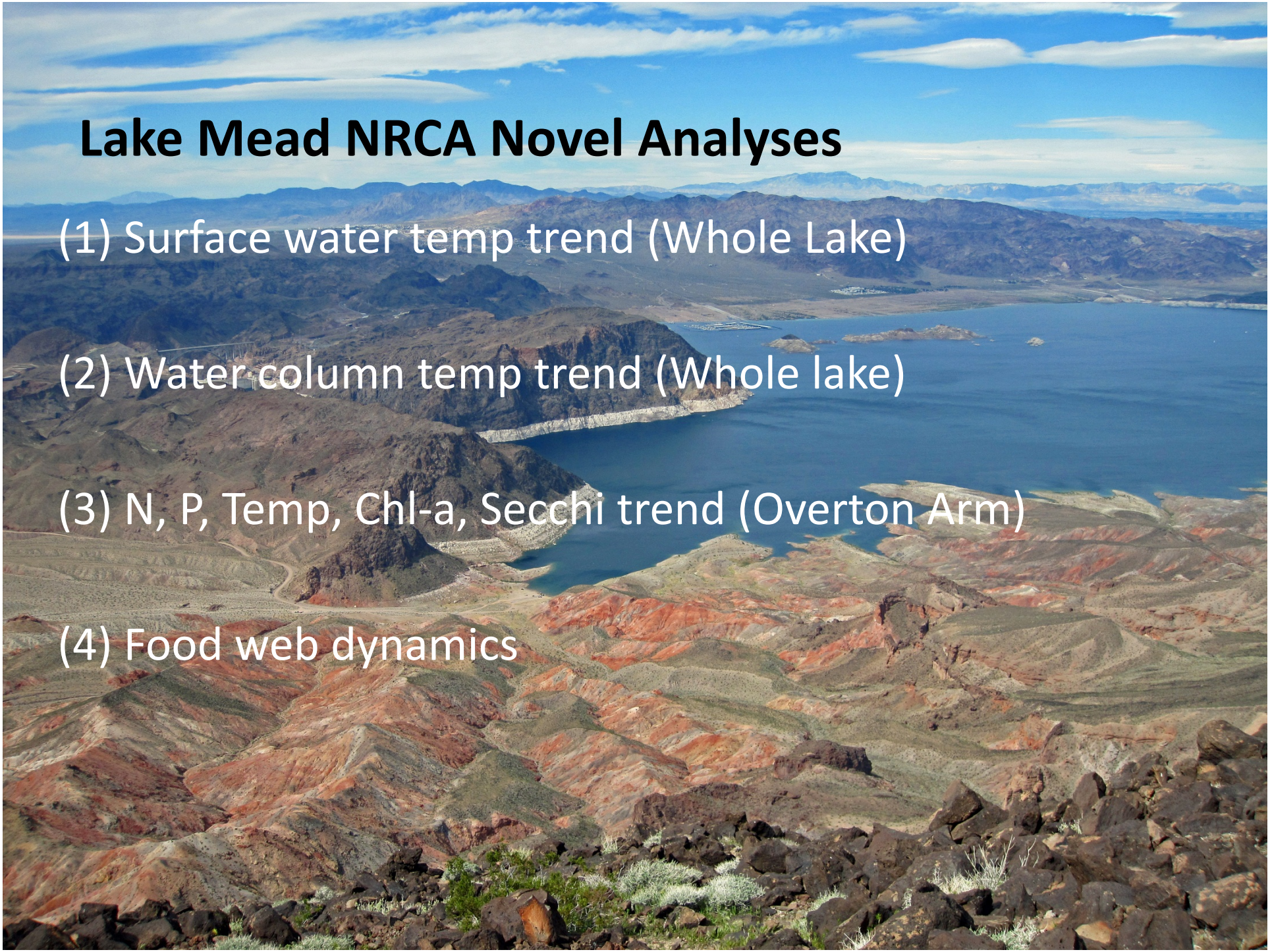
Indicator	Measurement	Metric	Scale of Analysis	Reference Condition	Data Source for Threshold
Aquatic Invasive species	Quagga mussel adult, Quagga mussel veliger, New Zealand Mudsnail, Crayfish	Density	Lake	Temporal Trends	(1) Wittmann et al. 2010 (2) USBR monitoring stations (3) SNWA veliger counts
Aquatic Vegetation	Occurrence	Presence/Absence	Lake	Summary information where available; Not much data exists, identify need for monitoring	(1) I&M Vegetation Map (2) USGS Circular (3) USDOI 2014 (4) Potentially researchers at DRI using Landsat 8, follow-up
Riparian Vegetation	Occurrence	Presence/Absence	Lake	Summary information where available; Not much data exists, identify need for monitoring	(1) I&M Vegetation Map (2) USGS Circular (3) USDOI 2014 (4) Potentially researchers at DRI using Landsat 8, follow-up
Chemical and Physical Characteristics					
Base Limnology/ Surface Water Quality	Existing data summary: (1) DO, Conductivity, pH (2) Secchi, Chl a, (3) Nutrients (TP, TN, Ortho P, NO3+NO2-N, NH4-N) (4) bromide, perchlorate (5) TOC New Analyses: (1) Surface water temp trend (Whole Lake) (2) Water column temp trend (Whole lake) (3) N, P, Temp, Chla, Secchi trend (Overton Arm)	Dependent on parameter	Lake basin	Consistent and recent anomalies, Departure from long term averages	USGS, USBR, Turner et al. 2010, USGS Circular 1381
Contaminants	VOCs, EDCs, Se, Hg	Dependent on parameter	Lake/ Tributaries	EPA standards	(1) USGS Circular 1381 and references therein

Lake Mead NRCA Indicators

Indicator	Measurement	Metric	Scale of Analysis	Reference Condition	Data Source for Threshold
Salinity	Salts, various	Concentration	Upstream and Lake Basin	Temporal Trends	(1) USGS
Recreation Suitability	Pathogens, HAB/toxins; aesthetics	Dependent on parameter	Lake/Basin	State stds/WHO/ EPA reports	(1) SNWA/NPS Joint Toxins monitoring (includes chl a as an indicator of algal suitability, per WHO and EPA guidelines) (2) NPDES Bacterial monitoring
Human Health Effects	Hg Fish, VOCs, EDCs, Pharma	Dependent on Parameter	Lake	State stds/WHO/ EPA reports	(1) USGS Circular 1381 and references therein
Ecological Processes					
Food Web Dynamics	Changes in food web structure	Trophic status	Lake	Qualitative evaluation, relative to recreational fishery and threatened species	(1) Umek et al. 2010 (2) Chandra, unpublished data (3) USGS Circular 1381
Near Shore Processes Due Lake Recession	Plant Colonization, Soil Properties	Abundance and native vs non-native species	Lake	Increase or decrease in native species colonization	Engel et al. 2014
Hydrology and Geomorphology					
Hydrologic regime	Colorado River runoff/Tributary flows	Volume	Watershed	Temporal trends	(1) USGS gauging stations (1950 - present, various inflows) (2) Turner et al. 2010 (3) USGS Circular 1391
Confluences/ Deltas	Size and location of confluences	Areal coverage, description of inputs	Watershed	Qualitative; size and location	Spatial analysis
Sediment	Sediment load; Nutrient loading (associated with sediments); TSS	Dependent on Variable	Lake	Temporal trends; likely qualitative description	(1) USGS (2) SNWA

Lake Mead NRCA Indicators

Indicator	Measurement	Metric	Scale of Analysis	Reference Condition	Data Source for Threshold
Watershed Mgmt	Powell Releases; Upstream Development (St. George, Mesquite)	Volume, Temperature (# of cold water incursions, by date), Water quality	Watershed; Lake	Qualitative description	(1) SNWA Water supply (2) USDOI 2014 (3) Batker et al. 2014
Floods	Floodflows in streams; Future Projections	Elevation	Tributaries	Qualitative Description	(1) USGS Gauges (2) USDOI 2014
Disturbance Regimes					
Development and Urbanization		This section will likely be a qualitative description/recount from other data sources of projected disturbances to the region or Mead NRA.			(1) Batker et al. 2014 (2) USDOI 2014
Climate Change					(1) Batker et al. 2014 (2) USDOI 2014
Aquatic invasive species					(1) Literature (2) USDOI 2014
Human Use	VOCs; sanitation; crowding				(1) Batker et al. 2014 (2) USDOI 2014



Lake Mead NRCA Novel Analyses

(1) Surface water temp trend (Whole Lake)

(2) Water column temp trend (Whole lake)

(3) N, P, Temp, Chl-a, Secchi trend (Overton Arm)

(4) Food web dynamics

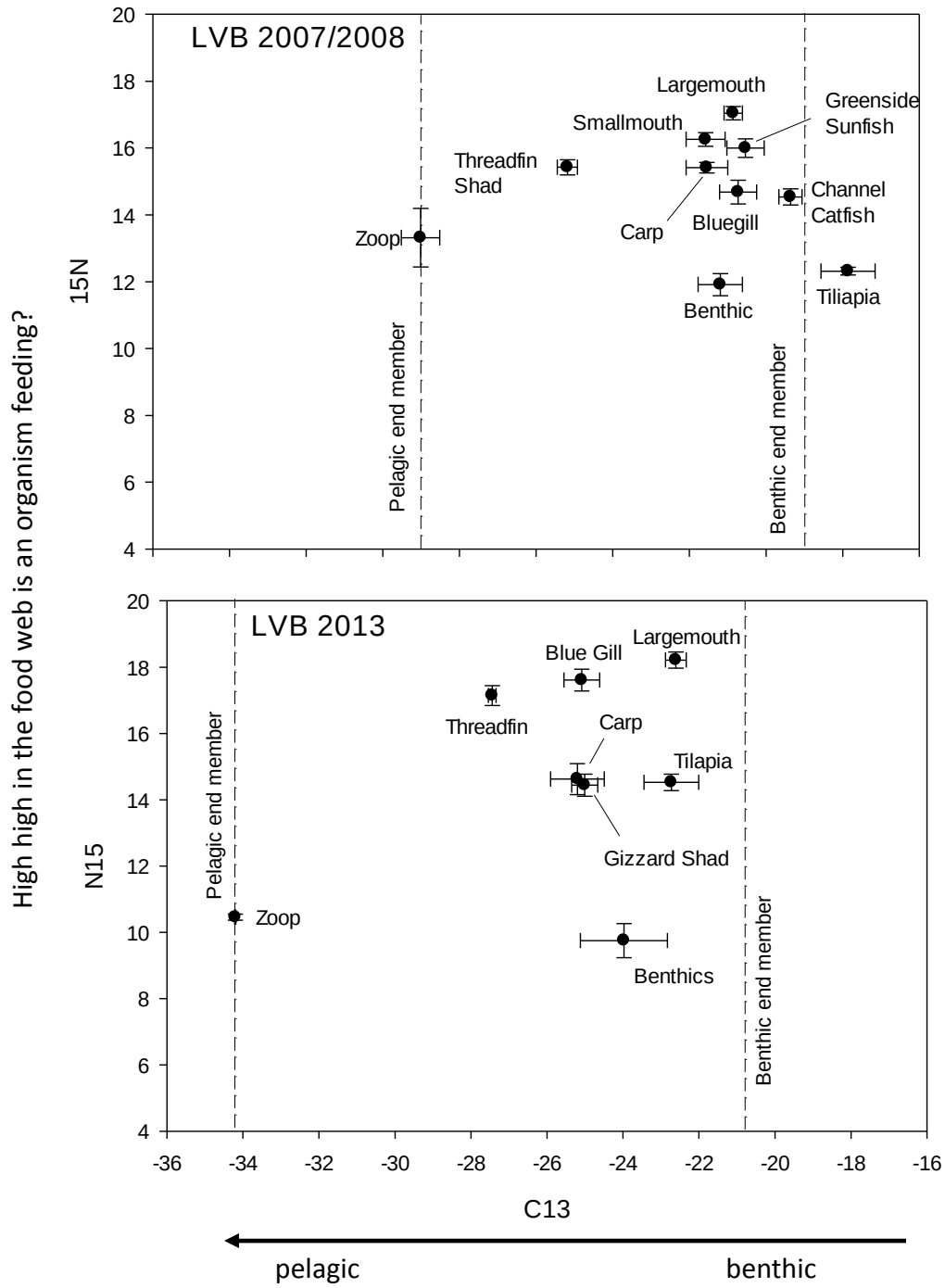
Products

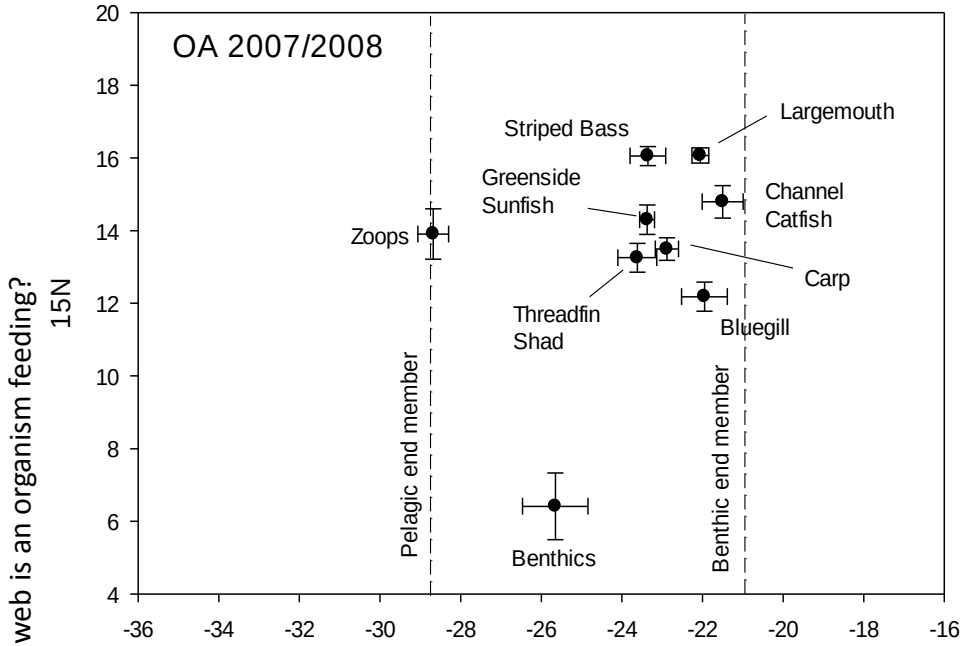
Report to include:

- Succinct statement of condition for each indicator
- Relevance and context of overall findings
- Identification of data gaps
- Scorecard: NPS NRCA Program Format
- Data and analytical methods
- Delivery to NPS of data and metadata

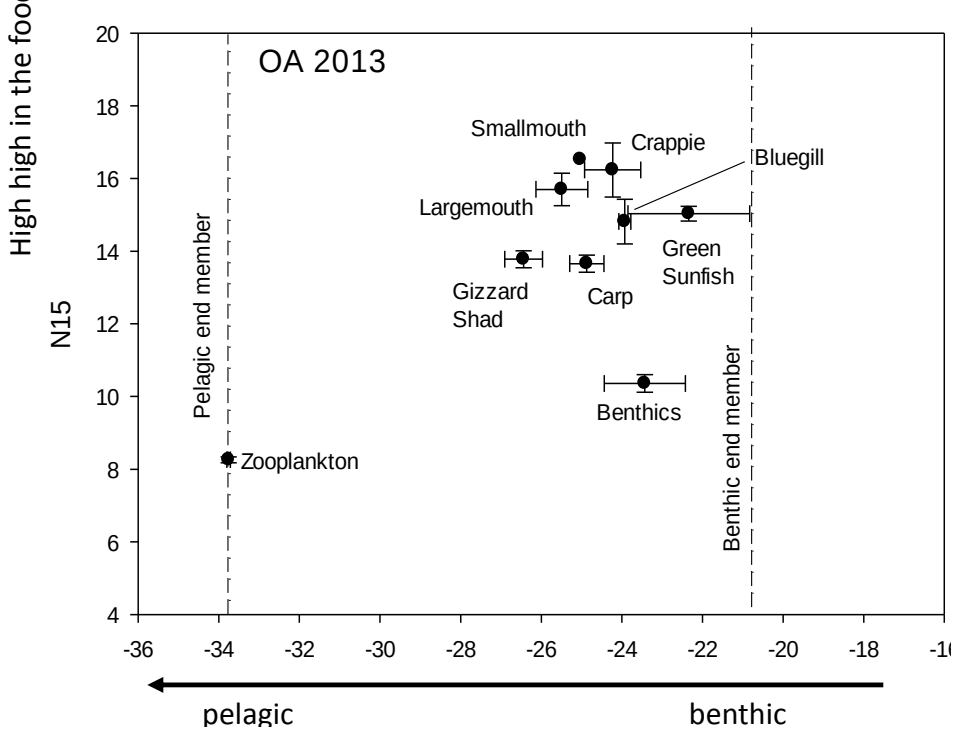
Food webs over time measured by natural isotopes

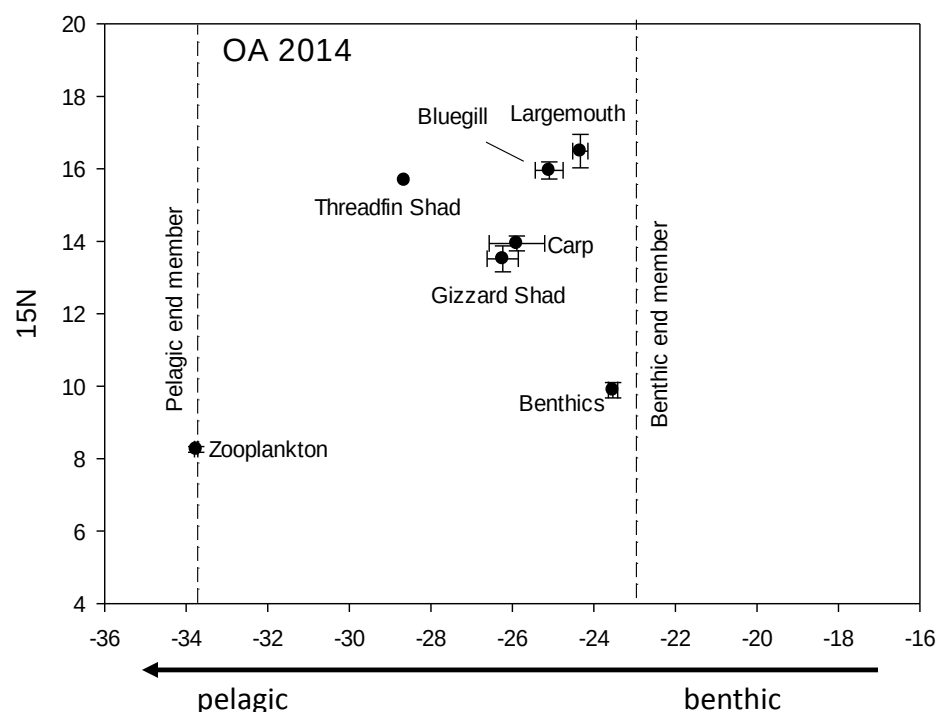
- Las Vegas Bay, littoral-benthic resources contribute to fishes
  - Threadfin shad less benthic (more pelagic) than other fishes including top predator large & smallmouth bass which obtain their energy from the littoral benthic zone
- Benthic resource contributions decreases from 2008 to 2013 with exceptions.
  - Largemouth bass, 83% to 84%
  - Bluegill, 85 to 74%
  - Carp, 76 to 68%
  - Threadfin shad, 40 to 41%
- Gizzard shad, important part of the food web, 69% energy from littoral benthic resources, likely supporting top predators

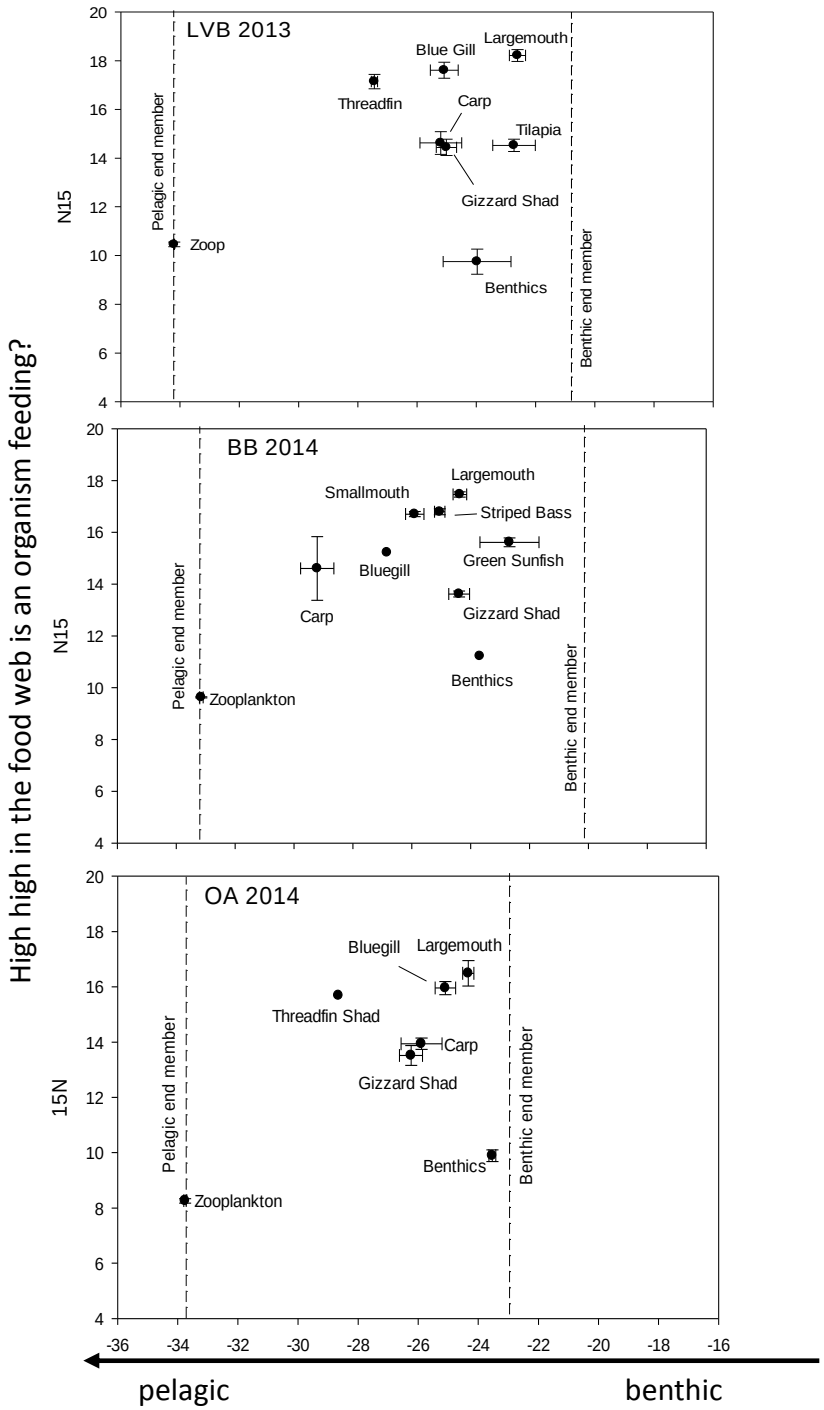




- Overton Arm, littoral benthic resources contribute to fishes
  - Threadfish shad 49 to 50%, slightly greater benthic contribution than Las Vegas Bay
  - Gizzard compared with threadfin obtain their energy from littoral-benthic resources.
- Variable feeding over time, with a greater amount of littoral benthic contribution from 2013 to 15 but only by 10% or so across species.







Contemporary comparison of bays/ basins across Lake Mead

- Variable resource utilization across bays; overall littoral-benthic resourced support the fishery
- Gizzard shad, utilize benthic resources (66-70%) across the bays and likely transfer energy to top predators (bass species)
- Carp and bluegill can be variable in utilizing benthic resources (e.g. more pelagic resources in Boulder Basin). Do they moving across basins or is there a greater coupling of pelagic phytoplankton supporting benthic invertebrates within this basin compared to others?

Supporting a wide variety of active recreation