**Wednesday, 8/10/2016 NC 1189 Meeting Notes**

**Participants**

In person: Bill Taylor (Michigan State University), Doug Buhler (Michigan State University), Dana Infante (Michigan State University), Paul Venturelli (University of Minnesota), Max Melstrom (Oklahoma State University), Kyle Hartman (West Virginia University), Andrew Carlson (Michigan State University)

Zoom: Katie Bertrand (South Dakota State University), Melissa Wuellner (South Dakota State University), Mike Kinnison (University of Maine)

**Introductions and Overview**

* Historically has been uncommon to receive multi-state Agricultural Experiment Station (AES) funds for freshwater fisheries-related research, but the magnitude of challenges (e.g., climate change, invasive species) and importance (e.g., food, finance, recreation, livelihoods ) contemporary fisheries issues combined with AES directors who care deeply about these issues (e.g., Dr. Buhler and invasive species) has provided us an opportunity to demonstrate the importance and value of these fisheries systems to others
* Purpose of our meeting this week is to begin to develop an integrative coupled human and natural systems (CHANS) framework for investigating the ecological and socioeconomic effects of change drivers, particularly focused on climate and invasive species on inland fisheries and aquatic resources
* To facilitate our knowledge base, we will send each member of the multistate team a book recently published by the American Fisheries Society based on the recent FAO-MSU sponsored meeting on global inland fisheries sustainability and the document produced as the summary of the meetings
* If anyone needs help on the administrative component of our multistate, Doug Buhler has suggested they contact Linda Haubert in his office at MSU. She is the Projects Administrator for MSU AgBioResearch: [maesprj@msu.edu](mailto:maesprj@msu.edu), 517-884-3863 and has helped us over earlier hurdles.

**Brainstorming session on how our project will be designed to address Objective 1 of our proposal (and an introduction of what interests NC 1189 group members can provide to the team)**

*Objective 1: Foster a collaborative, coupled human and natural systems research framework to assess the ecological and socioeconomic effects of climate change and invasive species on inland fisheries and aquatic resources.*

* Max Melstrom
  + Developed a model for spatial dynamics of stream fisheries when he was at Michigan State University, used the model to predict how species distribution and angler behavior may change with climate change
  + Worked with Frank Lupi (economist at Michigan State University) on invasive species issues: how to model invasive species spread, how to respond to invasive species from management and policy perspectives
  + Focuses on recreational fisheries, willing to expand to other areas
* Dana Infante
  + Climate change
    - Existing temperature models for Michigan streams and rivers, could be used to predict effects of fishes and thermal habitats
    - But need to account for changes in flow, which is more difficult, particularly in combination with changes in temperature
    - Work is rooted in a landscape perspective
    - Could collate creel data, fishing stocking data, etc. from state agencies to incorporate the human dimensions of fisheries into our project … potential application for SmartPhones and related tools (to allow anglers to help us collect data), and related to some of Paul Venturelli’s interests
* Paul Venturelli
  + SmartPhones and related tools are promising, but there are biases to account for (e.g., SmartPhone users tend to be younger, more urban)
  + Could use these electronic tools to characterize how climate change and invasive species affect anglers, and, in turn, how anglers influence climate change and invasive species
  + Changing fisheries and anglers (e.g., Lake Mille Lacs in Minnesota, walleye decline, bass expansion)
* Kyle Hartman
  + Climate change research tends to focus on species that respond (or are predicted to respond) negatively to climate change, but may need to account for species that may do better under climate change (from the perspective of recruitment, growth, and/or survival)
* Mike Kinnison
  + Climate change
    - Need to account for evolutionary processes associated with fish species and populations that may be influenced/exacerbated by climate change, include a bioenergetics approach
  + Invasive species
    - Need to account for interacting effects between invasive species and anglers, and how they affect the ability of fish populations to adapt
  + CHANS approach promoted
    - Vernal pool amphibians work at UMaine (working with ecologists and economists)
* Katie Bertrand
  + Research focuses on fish ecology, closely aligned with research conducted by Kyle Hartman and Mike Kinnison
  + Need to bridge the interface between ecosystem function and ecosystem *services*
  + Has performed invasive species research (silver carp and bighead carp in South Dakota rivers)
* Melissa Wuellner
  + Research interest in human dimensions, particularly the psychology and sociology of fisheries management. This area of expertise will be important for our efforts relative to climate change and invasive species (e.g., how will climate change affect anglers and non-anglers)
* Andrew Carlson
  + Applying the CHANS framework to fisheries in the context of climate change and invasive species will require consideration of reciprocal interactions (i.e., how do humans influence fisheries, how do fisheries influence humans, how might humans’ influence on fisheries change over time) and complex dynamics (e.g., feedbacks, legacy effects, surprises)

**Forecasting (what do participants envision for the future, relative to Objective 1)**

Mike Kinnison

* Need to account for feedbacks associated with CHANS, as well as the role of evolution in fisheries amidst climate change and invasive species

Melissa Wuellner

* Importance of leveraging resources to optimize our collaboration
* Possibility of collaborating on a National Science Foundation grant (Dynamics of coupled natural and human systems [CNH])
  + Need to account for reciprocal interactions between fisheries as human and natural systems (human to natural, natural to human, and how each changes with climate change and invasive species)

Dana Infante

* Spatial scale can be both large (coarse-grained projects) and small (multiple fine-grained projects)
* Regional Climate Science Centers (CSCs) or National Climate Change and Wildlife Science Center (NCCWSC) could be funding sources

Kyle Hartman: Could take the food/food security approach for research ideas and funding

Andrew Carlson: Need to consider the complexity of CHANS (e.g., feedbacks, legacy effects, surprises, resilience) and the importance of accounting for them in our research (and funding proposals)

Katie Bertrand: Have regular NC1189 update meetings (more frequent, shorter duration)

Bill Taylor

* Prototype projects (brainstorm pieces of the larger NC 1189 project)
* Law enforcement in fisheries – important to consider amidst climate change and invasive species
  + Kyle: could obtain metrics representing how often anglers move fish from place to place, locations, etc.
  + Paul: has enforcement records for Minnesota
  + Molly Good (Michigan State University) is working with the Great Lakes Fishery Commission-Law Enforcement committee

Max Melstrom: Current emphasis in economics is on human behavior, so the economic sphere of our NC1189 project is closely connected with the CHANS framework we seek to develop

Bill: All NC 1189 participants work within their own unique university settings in which “success” may be defined differently. How to account for this in our NC 1189 work? How to be successful at individual universities and as an NC 1189 group?

Katie: SDSU in limbo (new Wildlife and Fisheries Department Head, Dean promoted to President, new Interim Dean, difficulty traveling to NC 1189 meeting), yet personally interested in NC 1189 collaborations, common research interests and opportunities for cooperative success

Melissa: SDSU Ag Experiment Station tends to define “success” in monetary terms, similar to the environment at Oklahoma State (Max Melstrom)

\*Most NC 1189 participants collaborate with their respective state agencies to fund research, some with federal agencies (USGS, USFWS, USFS) and tribal agencies

* Melissa: emphasis on management-oriented research in South Dakota

Mike: good success with SWG (State Wildlife Grants) funding in Maine, also SWG-C grants (competitive)

Bill: perhaps all NC 1189 participants could contact their respective state agency directors, inform them of the existence and goals of our NC 1189 partnership

BREAK FOR LUNCH

(1:30 pm, afternoon session)

Structure for our NC 1189 work

\*\*Critical details of our proposed project: CHANS, climate change, invasive species

* One approach is to have a single overarching project that involves comparisons between/among states to help us characterize effects of climate change and invasive species on fisheries using a CHANS framework

CHANS – Natural components

* What metrics: fish distribution, production, and dynamics of community interactions (predation, competition, etc.)

CHANS – Human components

* Human behavior (preferences for species, locations, etc.), decision-making
* Economics
* Effects of climate change on humans via three pathways: 1) fish, 2) habitats, 3) direct effects on humans
* Effects of invasive species on humans via three pathways: 1) fish, 2) habitats, 3) direct effects on humans
* Tools
  + Pool existing data from fisheries agencies, published reports, etc.
  + Surveys

Mike: could start at the level of correlates (of invasive species introductions, etc. and connections to fisheries law enforcement officers)

* Survey 50 states fisheries management agencies: invasion rates of invasive species, available resources … “snapshot of the United States, state-by-state”
  + What they do now – expenditures, budgets
  + What they need to do amidst fisheries stressors
* Paul: start with a short-term paper demonstrating the importance of fisheries management agencies accounting for invasive species and climate change
* Could be useful for future grant proposals
* How to perform this research?
  + Mike: State wildlife/fisheries management reports (through SWG program, etc.) to evaluate how states perceive invasive species, how they spend money relative to invasive species
  + Melissa: use Larry Gigliotti’s expertise to inform our survey design; Larry is an Assistant Unit Leader for the USGS South Dakota Coop. Unit and has authored a climate change survey for South Dakota residents that we could use as a template for our survey
  + Dana: National Fish Habitat Action Plan (NFHAP) – could use it to gather data, but data availability would vary by region, process could be slow
  + Kyle: many agencies spend more time “fighting fires” than thinking long-term about climate change and invasive species effects, but good counter-examples (e.g., MNDNR, Florida FWC, Ontario MNR; Paukert et al. 2016)
  + Bill: start at national level, work down from there; or being with regions/groups of states (Kyle)
  + Paul: develop indicators for climate change (e.g., number of extreme weather events) or use existing climate change projections (Dana), use USGS maps for invasive species
  + Mike: ask managers to rate their top fisheries
    - Melissa: use state agencies’ annual surveys of licensed anglers
    - Max: could phrase the questions as five most beneficial (and harmful) species
  + Bill: we could survey AES directors in addition to state natural resource agencies (and possibly state environmental quality agencies)
    - Could be a way to inform AES about fisheries and fisheries conservation amidst climate change and invasive species
  + Melissa: we could complete a content analysis of fisheries publications (in context of climate change and invasive species)
  + Bill: avoid asking agencies, “what is your biggest issue?” (lack of funding)
  + Paul: one challenge we may have is evaluating state-specific impacts of invasive species (not simply introduction and distribution data gleaned from USGS maps)
    - USGS has rated state-specific impacts of invasive species (severe, unknown, etc.)
    - We could translate written descriptions into categorical rankings
  + Dana: could make initial statements in survey about each species’ ecological characteristics, socioeconomic importance, etc.

\*\*Initial short-term survey proposed for consideration as a beginning to our project

* Content
  + 5 most beneficial species, 5 most problematic (or harmful, deleterious) species
  + Relative resource allocation for addressing threats (large, medium, small or percentage ranges)
    - Kyle: Hypothetical budget increase (25%), how would resources be spent
    - Paul: Could use a website word count method and ascertain relative importance based on words frequency

CHANS dynamics (reciprocal interactions, feedbacks, etc.)

* Paul: important to link these two components, identify ideas for human and natural systems, find connections between them
* Objectives 1,2,3 build off of one another: 1 – large conceptual framework, 2 – human to natural connections, 3 – natural to human connections (complete the reciprocal interactions between human and natural systems)

“Model systems” (n = 2 in each state, 1 changed by climate/inv. Spp., 1 ~ unchanged)

* Minnesota: Lake Mille Lacs (walleye decline) vs. Red Lake (walleye expansion)
* Michigan: Great Lakes fishery (salmonine … invasive species and climate change connections)
  + Rivers and streams (coldwater, coolwater, warmwater systems)
  + Grayling (historical, cultural, ecological significance; potential interactions with brown trout)
* South Dakota: Missouri River (chinook salmon, rainbow smelt) … or Missouri River (walleye)
* Maine: lake trout, landlocked and anadromous Atlantic salmon, brook trout … Centrarchids in southern Maine, northern pike an invasion concern (last decade: switch from coldwater fisheries as dominant economic drivers to warmwater fisheries)
* Oklahoma: some reservoirs with invasive species such as zebra mussels (eg, Grand Lake); climate change: golden algae blooms in reservoirs valuable for recreational angling
* West Virginia: small impoundments with bass; some rivers with expanding bass populations, others with inconsistent (declining?) bass populations

Closing comments for Day 1

Please all think of ways that this program could best function:

\*\*Brainstorm ways to compare fish species groups between/among states

\*\*Brainstorm questions for these systems, pool the and identify common ground for a multistate assessment

**Thursday, 8/11/2016 NC 1189 Meeting Notes**

Participants: Bill Taylor, Dana Infante, Paul Venturelli, Max Melstrom, Kyle Hartman, Andrew Carlson (in person); Katie Bertrand, Mike Kinnison (Zoom)

Tasks: Today our focus will be on implementing research programs on Objective 2

*Objective 2: Analyze the ecological, environmental and socioeconomic factors which mitigate or exacerbate the introduction, establishment, or effects of invasive species and climate change effects at multiple spatial and ecological scales.*

\*\*Brainstorm ways to compare fish species groups between/among states

\*\*Brainstorm questions for these systems, pool the and identify common ground for a multistate assessment

Bill: thanked the group for the excellent and lively discussions of the first meeting day (8/10) and emphasized the importance of communicating our ideas to Doug Buhler, our administrative advisor who will share with other Directors. Bill said that Doug will be absent today but thanked the group for their efforts and hard work. Bill and Andrew will be meeting with Doug to debrief at the end of August.

Andrew provided a summary of yesterday’s activities, briefly discussed what the group will cover today

Bill asked the group to brainstorm particular locales and fish species that may be best for our group to focus on

* Mike: bass (invasion fronts, etc.), brook trout (thermal tolerance, community structure, etc.), Atlantic salmon in Maine
  + Combining our specialties in bioenergetics, evolution, ecology and ecosystem services
  + Constraints to working with Atlantic salmon (ESA permits, etc.), landlocked populations easier to work with from a permitting perspective
  + Reasonably large amount of data availability in Maine
  + Maine represents the southern limit for many fish species, so climate and climate change are always high-priority issues, along with invasive species
  + Invasive crayfish are an issue in Maine (e.g., rusty crayfish)
* Dana: lots of opportunity in Michigan
  + Grayling, brook trout, Great Lakes salmonines
  + Grayling: good understanding of available physical habitat in Michigan, also temperature models … but we need more investigation of how dams affect temperature (as the Michigan DNR is proposing to introduce grayling into mainstem environments as opposed to headwaters)
* Kyle
  + West Virginia has a dividing line between brook trout and smallmouth bass; competition and predation
  + Interactions between brook trout and non-native salmonids are not as prominent in West Virginia as in other states. Stream/river temperature, population isolation, and land use are more important issues
    - Eastern Brook Trout Joint Venture (EBTJV): lots of existing data on population status, land use, stream habitat, brook trout vulnerability
    - Dana: online and in-print products from the EBTJV are available
  + Land use: forest harvest, combined with climate change, may drive species such as brook trout out of certain areas of West Virginia
  + Gas lines: straight patterns up and down mountains, cause sedimentation in streams
* Max
  + From an economic perspective, bass and trout are highly valuable in Oklahoma (and West Virginia, Maine, Michigan)
  + Economically, bass are the most important species group in Oklahoma
  + Bill asked about the effects of floods and droughts (i.e., climate change) on fisheries in Oklahoma; mentioned striped bass, as an introduced species, could be insightful for our group to study
* Paul
  + Mille Lacs – Red Lake comparison (walleye): would serve as a case study for Minnesota and other areas in the Upper Midwest
    - Advantages of this comparison: abundant data in both systems; climate change and invasive species are affecting Mille Lacs (not Upper and Lower Red); people move between the two lakes (important human dimensions to consider)
* Katie
  + 1) Black Hills, mountain suckers – vulnerable to climate change, human dimensions component
  + 2) Sandhills, relict dace species (northern redbelly, finescale, pearl) – vulnerable to land use change (expansion of agriculture), socioeconomic effects (ranchers switching to agriculture), human dimensions component
  + 3) Coldwater lithophilic fishes: vulnerable to climate and land use change
  + Broader issue (in addition to climate change, invasive species): stream fragmentation
  + No native salmonids in South Dakota (including all trout populations in the Black Hills)
  + Silver carp and bighead carp are present in the James River drainage (up into North Dakota), half way up the Big Sioux River drainage

Ecological, environmental, and socioeconomic factors that mitigate or exacerbate effects of invasive species/climate change

Dana

* + Dam removal, riparian buffers (mitigation tools)
    - \*\*mitigation options tend to be site/region-specific, not universally applicable
    - Future research
      * Relating habitat degradation and presence of invasive species
* Max
  + Anglers moving species (including AIS) from water body to water body
  + Angler behavior: e.g., switching from fishery A to fishery B after fishery A declines
* Kyle
  + Human demographics and culture will influence distribution of invasive species
* Paul
  + Movement of boats is key (for fishing, recreational boating activities)
  + Must consider the relative importance of recreational activities, time of life (i.e., work, family commitments)
  + Could add cisco (highly vulnerable to climate change) to the list, but would be difficult to find a “human system” for cisco in Minnesota
* Mike
  + Cultural homogenization for preferred species (bass, black crappie, etc.)
  + Anglers intentionally move species such as black crappie into water bodies (ice fishing importance with decline of white perch)
  + Invasive species may not cause extensive economic harm in Maine but will likely be ecologically deleterious
* Andrew
  + Socioeconomic factors that may exacerbate climate change/invasive species: lower recruitment and retention of anglers, hunters, conservationists; nature deficit disorder; agency funding constraints; outdated budgetary models for agencies
  + Examples of climate change/invasive species mitigation in Minnesota: expanded watercraft inspections programs (Minnesota DNR); mobile boat-washing stations at boat landings; increased invasive species law enforcement; Minnesota Aquatic Invasive Species Research Center at the University of Minnesota (investigating chemical and molecular tools for invasive species management)

Socioeconomic factors that exacerbate/mitigate climate change/invasive species

* Angler recruitment and retention, nature deficit disorder (young people “distracted” by video games, computers, etc.)
  + Decreased recruitment of young anglers could reduce the spread of invasive species, but with fewer anglers, agencies may face more financial constraints (i.e., less money to allocate to invasive species and climate change mitigation)
* More generally, angler demographics
  + Average age of Federation of Fly Fishers member is >65 nationwide, few young members
  + Changing family and household demographics (e.g., children being raised by single parents—generally female)
  + Changing demography, mobility, information spread, desirability of fish species
* Fisheries tend to become less relevant for some needs (food), more relevant for others (recreation, sport fishing)
* Agency funding constraints
  + License cost structure (costs for residents vs. non-residents vs. retirees; lifetime licenses, conservation [reduced bag] licenses) – how does it vary among states? How variable are license fees across the United States?
  + Number of license sold in-state vs. out-of-state, within-agency license comparisons over time (e.g., Michigan DNR 1976 to 2016)
    - Could use National Survey Fishing, Hunting, and Wildlife Associated Recreation
  + Extant data for creel surveys, distances anglers travel to fish, willingness to pay
* Outdated budgetary models for agencies? Potential to embrace corporate funding sources?
* Water diversion from reservoirs and rivers (where it can support fish) to irrigation, etc.
* Technology and information
  + For finding fish, for sharing with other anglers (“swarm intelligence”)
* State of the economy in general influences how people allocate their leisure time (driving to a distant fishing location vs. driving to a nearby fishing location vs. not fishing)
* Access points: can anglers access certain water bodies? Can certain boat types access the water body?
* Regulatory environment controlled by agencies: where agencies allow anglers to fish, how they allow them to fish, etc.
* Competing uses and values: fish and wildlife versus energy, agriculture, development
  + Related to valuation and cost-benefit analysis – how much are fish worth? How much are fish habitats worth?
* Need for education and law enforcement amidst climate change and invasive species

Discussion of nationwide survey (initially discussed yesterday)

* Who to send the survey to?
  + State agency fisheries chiefs (start with them)
  + State agency invasive species coordinators? Federal agency fisheries directors? AES directors? NGOs? Public?
  + State agencies: chiefs vs. biologists, could lead to different perceptions
  + Agency perspective or personal viewpoint of the individual surveyed?
    - Agency perspective may be more important if we are focusing on how agencies allocate/will allocate resources
    - Assumption that agency resource allocation reflects importance, prioritization?

Bill: suggested a monthly conference call for NC 1189 to keep the group on track and moving forward

* Send out Doodle poll for days and times
* Send out Zoom videos to NC 1189 participants

BREAK FOR LUNCH

Afternoon session (1:30-5:00)

Dana: need to discuss short-term and long-term goals for our multi-state project

Short-term

* Nationwide survey and paper within the next year
  + Collaborate as a group, identify key questions and appropriate methodology for synthesizing state-specific case studies in the future
  + Need to identify who will lead survey design, implementation, analysis, writing
  + Need to identify necessary datasets and tools
    - Non-native aquatic species maps (USGS)
      * Paul: invasive species data and map-based product from Mike Hoff, Regional AIS Coordinator (USFWS, Minneapolis, MN)
    - Climate and climate change
      * Hostetler: climate change projections at the national level
      * Dana: best to focus on air temperature, precipitation metrics
* Use survey to inform National Needs program and apply for a national needs grant (Association of Fish and Wildlife Agencies)
* Individual NC 1189 participants pursue state-specific projects (related to NC 1189 goals) as they arise … as each state will have opportunities at different times
* Send survey to AES Directors
  + *Futures* (Michigan State University AgBioResearch publication): highlight the importance of freshwater fisheries using a CHANS framework for fisheries, etc.
  + National AES publication?
  + Key is to keep fish in their sights

Long-term

* Integrate state-specific projects into a synthetic, multistate CHANS initiative with funding from Federal sources such as NSF, USGS, State Agencies, foundations and NGO’s etc.

Overall visions for NC 1189 project (5-year)

* Paul: exciting opportunity to illuminate angler behavior and, more broadly, human dimensions
* Max: looking forward to opportunities for collaboration, legitimizing climate change-fisheries connection (alongside climate change-agricultural connection at Oklahoma State University)
* Dana: looking forward to learning more about the socioeconomic side of fisheries and the opportunity to collaborate
* Kyle: short-term paper will inform the group, and fisheries managers, of the status of fisheries amidst climate change and invasive species
* Andrew: advancing the science of fisheries as CHANS, taking the recommendations of previous papers (to treat fisheries as CHANS) to a new level (comprehensive, multistate CHANS assessment)
* Bill: increasing the visibility of fisheries and how fisheries are affected by climate change and invasive species; making sure the agencies and other partners (e.g., AES) we work with recognize the importance of fisheries amidst climate change and invasive species

Nationwide survey

* What are our goals for the survey and paper?
  + Fact-finding to learn whether or not (and how) we need to inform our partners of the significance of fisheries amidst climate change and invasive species
  + Evaluate how natural resource agencies view the importance of climate change and invasive species
  + Compare states in terms of the importance they place on climate change and invasive species, as measured by resource allocation
* Start by sending the survey to fisheries chiefs
* How to distribute the survey?
  + Email link to SurveyMonkey
* Survey structure: require participants to check only one box? Or more than one?
* Questions (see Kyle’s notes for actual order and wording)
  + Which state do you work in?
  + 5 most important freshwater fish species
    - Why fisheries ranked as most important
    - Categories: subsistence/consumption, recreation (consumptive, catch & release), commercial, conservation, cultural
  + 5 most problematic aquatic species (including fish, plants, etc.)
    - Why fisheries ranked as most problematic
    - Categories: human health, ecological impacts, economic impacts, industry
  + Rank the importance of various issues (water quality/use, habitat, disease and fish health, AIS, research/assessment, climate change)
  + How many people that work for your agency have the following primary job responsibilities?
  + Allocation of finances (budget)
    - List major spending categories (including invasive species, climate change, and “dummy” categories: habitat management, hatcheries, water quality/water use, disease and fish health, coldwater fisheries, warmwater fisheries, equipment and facilities, other … research and assessment, administration, public education, other)
      * Ask respondents to fill in percentages allocated toward each category (such that percentages add to 100%)
    - List major categories where personnel devote their time (\*same categories as above)
  + If your agency received a 25% budget increase, to which of the above categories will it allocate funds (and in what percentage)? [\*same categories as above]

**Friday, 8/12/2016 NC 1189 Meeting Notes**

Participants: Bill Taylor, Dana Infante, Paul Venturelli, Max Melstrom, Kyle Hartman, Andrew Carlson (in person)

Tasks:

\*\* Discuss objective 3 potential activities

*Determine the socioeconomic and environmental factors that influence the ways in which individuals and organizations respond to invasive species and climate change and the likely consequences of those responses for effective inland fisheries and aquatic resource management.*

\*\* Review the draft of our nationwide survey, make any necessary changes, send draft to all NC 1189 collaborators

\*\* Meeting summary and future directions

Bill: have a group conference call in ~3 weeks (after AFS meeting) to review progress on our survey, Institutional Review Board (IRB) approval, etc.

Create a Doodle poll to schedule monthly NC 1189 conference calls

Nationwide survey of fisheries chiefs (see survey)

\*\*\*Notes on questions we discussed in detail

* Question 1 … include multiple sub-questions
  + “What state do you represent?”
  + “How many permanent fisheries staff does your agency employ?”
  + In what ways are fish important to your state?
    - Boxes for recreational, commercial, cultural, etc.
  + “Does your agency have authority over water quality and quantity issues?”
  + “How many permanent water quality? staff does your agency employ?”
* Question 4
  + Add “From your perspective as a Fisheries Chief …” to the beginning of this question
  + Rank the categories 1-6 from most to least important, instead of rating “not at all … highly important”? Or will the spectrum “not at all … highly important” give use the information we need? Or both rating and ranking?
  + Phrase each category as a threat. Add the following categories:
    - “Inadequate knowledge”, “Inadequate research and assessment”
    - “Reduced fish production”
    - Other
* Question 5
  + “Approximately how many people in your agency have the following primary responsibilities: “
  + Use categories of numbers of people (0-5, 6-10, etc.)

Survey AES Directors regarding fisheries and climate change, invasive species

* Survey would be similar to survey of fisheries chiefs
  + But categories would include agricultural issues: row crop agriculture, animal agriculture, etc.
* Gauge whether or not AES Directors know about the importance of fisheries surveys amidst climate change and invasive species
* Survey could serve as an educational tool
* Demographic information on AES Directors
  + Background, disciplinary expertise
  + Where they received their Ph.D.
  + Number of years as Director
  + Do you interact with fisheries and aquatic agencies (e.g., state, NGO)?
  + Do you fish?
  + How many FTEs work in your AES?
  + How many are allocated to fisheries in the following sub-disciplines?
    - Aquaculture
    - Ecology
    - Management
    - Genetics
* Which of the following do you consider to be threats to fisheries?
  + Water quality/water use
  + Habitat degradation
  + Disease and fish health
  + Aquatic invasive species
  + Inadequate research and assessment
  + Climate change
  + Inadequate fish production
  + Other \_\_\_\_\_\_\_\_\_\_\_\_
* Budget questions
  + If you received more funding, to which fisheries and aquatic issues would you allocate it?
    - Water quality/water use
    - Habitat
    - Disease and fish health
    - Aquatic invasive species
    - Research and assessment
    - Climate change mitigation
    - Other categories?

Multistate CHANS framework for our project (long-term goal)

* How to conduct complementary research in multiple states?
  + Identify comparable systems and species
  + Select fisheries that exemplify CHANS (or CHANS dynamics)
* What fundamental common questions to ask?
  + How are AIS influencing the fish species of interest? OR, How are stressors influencing the fish species of interest?
  + How has the abundance of popular game fish changed over time?
  + How have AIS and climate changed over time in systems of interest?
  + How have these changes in AIS and climate impacted the system?
  + How have regulations changed over time? [human systems response to changes in the natural system]
  + How have anglers responded to changes in the fishery? [behavior: species harvested, frequency of trips, etc.]
  + What about other questions/framework??