Appendix #1 Comparison of 11 Approaches for Analyzing Adaptive Capacity: Strengths, weaknesses, insights, implications and applications. Key references are included of case study examples and reviews for each method, where available.

Approach	Description	Details	Strengths, Weaknesses	Insights, Implications, Application	Key References
Large scale social indicators	Studies of relative adaptive capacity (or inversely related indicators of vulnerability), based on existing socio-economic or social data across the system.	Key Methods: Relative community assessments of risk exposure (e.g. to climate change), system sensitivity (i.e. resource dependence), and adaptive capacity of the social system (wealth, governance, assets, learning, etc.). System focus: Social Scale of Analysis: Communities to state to cross-national Temporal Focus: Present	Strengths: Can provide rapid outcomes for decision makers, and be useful for communicating differences in vulnerability and adaptive capacity among different regions, populations and communities. Relatively easy to conduct - relies on simple surveys at community level (e.g. from focus groups and RRA type research) or on secondary data. Weakness: Indices are often generic, theoretical, and composite: Difficult to evaluate. Doesn't allow for evaluations of the effectiveness of responses; difficult to incorporate traditional or cultural knowledge. Relative measures only; difficult to apply to policy for building adaptive capacity in a particular place.	Insights: Allows a broad understanding of potential relative response to stress or opportunities, generally related to how the combination of hazard exposure, dependency (sensitivity) and adaptive capacity led to differential vulnerability. Implications & Applications: Local management is not very responsive at this scale. Useful for policy and governance insights across communities or regions.	(Himes-Cornell et al. 2016) (Himes-Cornell and Kasperski 2015) (Barange et al. 2014) (Hughes et al. 2012) (Allison et al. 2009) (Brooks et al. 2005) (Yohe and Tol 2002)

Large scale ecological indicators and models	Modeling of past and present ecological changes and future adaptation potential of species and fisheries along with projected environmental changes	Key Methods: Mean responses to changes in environmental conditions: species distribution shifts, species' adaptive capacity index, rate of evolutionary changes. Attention to: Ecological Scale of Analysis: Species, biological communities, and fisheries (e.g. Large Marine Ecosystem scale) Temporal Focus: Past, present and future.	Strengths: Reveal large-scale pattern of adaptive responses and capacity to adapt to ecological change from both the perspective of species, and the fishery response to that change. Weakness: Low resolution because of limitation of data or model, need downscaling to be directly usable for regional and local scale studies; confidence is limited by the state of knowledge on species' and fisheries' adaptive responses.	Insights: Understand how species are responding to changing conditions through distributional changes, and how some fisheries are adapting to that through changes in species composition of catches. Implications & Applications: The rate of evolutionary adaptation may not be fast enough under the current rate of warming, particularly for species that have a low adaptive capacity (e.g., low genetic variability, slow turn-over rate). This tool is policy relevant for larger regional/national governance, and can be applied to identify species/fisheries most vulnerable to climate change.	(Cheung et al. 2013) (Cheung et al. 2012) (Gattuso et al. 2015) (Cheung et al. 2015) (Sumaila et al. 2011) (Lam et al. 2014)

Integrated social-ecological indicators	Studies of the adaptive capacity of social-ecological systems based on existing socio-economic and ecological data within or across systems	Key Methods: Assesses the adaptive capacity of social-ecological systems based on ecological and social data (e.g. time series of catches, biomass, ocean conditions, market price, participation). Uses existing data, key informant interviews. E.g. IMBER ADApT (Assessment of Responses based on Description, Appraisal and Typology): Vulnerability, Governability, Response and Appraisal. Attention to: Social-ecological Scale of Analysis: At all scales: Individual to multi-communities to state to cross-national Temporal Focus: Past to present, with lessons for future integration of existing studies.	Strengths: Combines multiple properties and characteristics of the system into a smaller number of variables with similar or greater descriptive power (similar to indicators of human health). E.g. The I-ADApT framework combines both quantitative and qualitative responses to enable more explanation of motivation, etc. The questionnaire format allows people involved in the event to express their opinions. Responses can be timely (e.g. as an event is happening) and does not necessarily rely on subsequent written/published reports. Weakness: Data intensive. Often considers relative measures: difficult to apply to local management. No evaluations of effectiveness of responses. Can be at an overly coarse scale with less application to local communities.	Insights: Understanding of trade offs in fisheries adaptation: In times of rapid change (i.e. climate change), allowing for adaptability by fishers will be critical for the survival of their livelihoods. The I-ADApT framework provides insights which include both natural and social system attributes and responses, as well as how they were integrated. Practical solutions pertain to how scientists, managers, and communities involved in the event responded, at both short and longer time and spatial scales, across cases. Implications & Applications: Need more rapid and effective responses to marine social-ecological crises/events - relevant at a larger policy/governance level for management. IMBER-ADApT can be applied across cases based on a core set of indicators. This method has been applied to case studies (e.g., Monterey Bay, California), and is currently in development.	(Aguilera et al. 2015) (Bundy et al. 2015) (Perry et al. 2011) (Barange et al. 2010) (Miller et al. 2010) (Cinner et al. 2013) (Cinner et al. 2012)
Governance approaches	Approach to understand the role of institutions (rights, rules, norms) and governance dimensions of vulnerability and AC. Assessments not typically framed *a priori* by	Key Methods: Assessment of governance often through conventional social science techniques (semi-structured interviews, focus groups, etc.);	Strengths: Opportunity to consider the role of existing institutions and governance arrangements in facilitating capacity of communities to adapt to change (i.e., as a dimensions of	Insights: Understand the role of networks and multilevel governance important attribute of adaptive capacity Institutions as pathways for	(Dietz et al. 2003) (Gupta et al. 2010) (Pahl-Wostl

	suites of indicators, but rather insights on institutional and governance dimensions of vulnerability and AC developed inductively from case experiences. Where the focus has been more directly oriented towards institutions/governance, some established attributes and indicators are available.	sometimes indicators used Attention to: Linked social-ecological systems and role of institutions and governance processes in mediating human interaction with the environment Scale of Analysis: Local (community-based institutions and governance arrangements) to macro (national, supra-national arrangements) Temporal Focus: Past, Present; Possible to use for future scenario planning.	vulnerable and adaptive capacity); the importance of assessing the capacity of actors to modify institutions in response to change; and that governance is multi-faceted and requires assessments of daily practices of governance, issues of institutional design and its implications, and values and principles that frame governance Weakness: Limited attention to relations of power; emphasis is on governance as context, rather than an analytical lens with which to consider principles and values, institutional design, social practices (e.g. learning). Inadequate attention to the nature of change (i.e. incremental change versus thresholds of change or regime shifts).	knowledge co-production and social learning needed for adaptive capacity Understanding of community-based institutions (customary practices, norms) as sources of adaptive capacity, renewal. Implications & Applications: Enhanced understanding of the social and institutional (formal, non-formal) capacity of actors at multiple levels to make decisions about adaptation, and the linkages/feedbacks among decision making levels about adaptive capacity. Opportunity to apply governance and institutional assessments at multiple levels; contribute to bottom-up and top-down assessments of vulnerability and adaptive capacity.	2009) (Brown et al. 2010) (Smit and Wandel 2006) (Armitage and Plummer 2010)
Multiple community surveys	Studies between several communities where adaptive capacity is measured through assets and actions taken to respond to change. Indicators based on the 5 capitals (human, financial, physical, social, natural) and adaptive strategies.	Key Methods: Household surveys, semi-structured interviews, focus groups Attention to: Interactions between social and ecological stressors, livelihoods Scale of Analysis: Household to community Temporal Focus: Recent past (1 year) to present	Strengths: Allows for inclusion of cultural, historical, or traditional adaptive techniques. Leads to an understanding of potential barriers to adaptation (e.g., economic, cultural). Personal descriptions of adaptations show that strategies vary by socio-economic status (e.g. diversification vs. intensification for poor to wealthy fishers), with differentially impacts on the ecological system	Insights: Insights into how social dynamics constrain or facilitate adaption and what the social/ecological consequences might be (e.g., intensification can increase pressure on resource), which provides better information for intervention depending on the goal of the intervention (e.g., interventions trying to reduce pressure on the resource by diversifying wealthy fishers' livelihoods may not work in this context).	(Blythe 2014) (Blythe et al. 2015) (Blythe et al. 2014) (Cinner et al. 2011)

			(e.g., diminishing vs. amplifying feedbacks). Weakness: Lower explanatory power and intervention actions as specific strategies are highly context specific	Implications & Applications: A more nuanced understanding of livelihood diversification as an adaptation strategy and of material wealth as for a potential barrier for adaptation. Methods can inform interventions to foster adaptive capacity or reduce vulnerability in communities or across sectors	
Social experiments	Social: Field economic experiments where individuals make hypothetical decisions (for economic rewards) based on real-world daily decisions and behaviors relevant to their livelihoods and context.	Key Methods: Economic experiments: Individual choice behavior (Catch decisions). Attention to: Social Scale of Analysis: Local (individual and community) Temporal Focus: Fishers are using past experiences to make catch decisions in the present (which is what we are measuring), and are also reflecting on how these lessons are applicable for the future.	Strengths: Allows researcher to understand fisher decisions in response to different sources of uncertainty in a controlled and replicable way. May also have pedagogical value in providing a platform for reflection in an interactive environment about daily decisions and behavior. Weakness: Unless used with other approaches (i.e. interviews, surveys) does not answer questions about *why* some fishers respond and behave differently or have different levels of adaptive capacity.	Insights: Fishers (within this context) have agency to confront change and uncertainty by adjusting their fishing behaviors to counteract declines in fishery resources. It is a useful way to look at the social-ecological feedbacks of multiple drivers. Implications & Applications: Using this method provides an interactive space for reflection which could induce favorable (increased communication) or unfavorable (exacerbation of power asymmetries) changes in the community itself. No known applications of the results to action.	(Camilo Cardenas and Carpenter 2005) (Castillo et al. 2011) (Gelcich et al. 2013). (Finkbeiner 2015)
Species level experiments	Lab or field based studies in which the responses of populations within a single species are assessed with respect to a particular stressor (e.g. temperature, water chemistry). The objective is to assess adaptive capacity	Key Methods: Ecological experiments assess genotypic or phenotypic variation in observable traits (or loci) within species or populations exposed to different environmental conditions (e.g. temperature,	Strengths: Conceptually simple experimental design (e.g. factorial breeding designs); Provides quantitative estimates of genetic variation, heritability or phenotypic plasticity for species and/or populations of species; Can provide evolutionary potential	Insights: Provides species-specific quantitative assessment of evolutionary potential; quantitative estimates obtained can be combined with demographic information in model simulations to predict future species persistence and	(Bernhardt and Leslie 2011). (Jensen et al. 2008) (Reed et al.

	(genotypic variation and/or phenotypic plasticity) to variation in environmental conditions.	different CO2 concentrations). E.g. Breeding designs, "common garden" experiments, molecular or genomics approaches, meta-analyses. Attention to: Ecological Scale of Analysis: Multiple populations/stocks (regional) Temporal Focus: Assess genetic adaptation or plasticity in traits to help explain current species distributions or predict future adaptive and evolutionary species responses.	based on a single generation. Weakness: Logistical constraints on the number of species and/or populations that can be included in a single study; Controlled lab experiment does not account for natural variability in aquatic systems. Does not account for multiple interacting stressors (e.g. increased temperature and higher CO_2) or trait correlations; Experiments that target specific life-history stage or single generation do not capture multigenerational evolutionary potential. .	community dynamics; gain insight into what species and/or populations have more/less potential for future adaptation. Implications & Applications: Susceptibility to changing environmental conditions varies between species and between populations of the same species: implications for species management (e.g. managing to maintain stock diversity or standing genetic variation, fisheries targeting, and species conservation priorities and approaches). Can apply to selection of populations/stocks/species for aquaculture, hatchery breeding programs), changes to fisheries objectives.	2011) (Crozier et al. 2008) (Hutchings 2011) (Whitney et al. 2013) (Munday et al. 2013) (Sunday et al. 2011) (Muñoz et al. 2014)
Historical ethnographic approaches	Analysis of past adaptive responses within a community or among several communities; at a household or community level. Indicators are based on historical knowledge, traditional engagement with ecological community, traditional ecological knowledge (TEK) holders	Key Methods: Understanding traditional knowledge systems and past adaptations; identifying times of change or stress in historical/archaeological record, oral histories, and personal experiences and analyzing responses to change Attention to: Social-ecological (integration) Scale of Analysis: Local to regional Temporal Focus: Past, recent	Strengths: Understanding of past types and scale of change, and what cultural/social/ ecological adaptations occurred in response; people can relate to changes experienced by ancestral peoples; can inspire adaptive capacity in contemporary circumstances Weakness: Past changes and adaptations many not be relevant to modern circumstances; Takes time to gain community trust and acceptance; Not necessarily applicable at large scales.	Insights: Knowledge transmission and sharing through stories and ceremonies contributes greatly to adaptive capacity of people and communities. Strong social structures really help communities adapt, along with access to resources. Knowing how ancestors have responded to and overcome changes and difficulties can inspire people to face and adapt to change in their own lives Implications & Applications: Communities where strong ties	(Alcorn et al. 2002) (Atleo 2011) (Berkes 2012) (Berkes et al. 2000) (Berkes et al. 2003) (Ford and Martinez 2000) (Menzies

		and distant		between generations are apparent also benefit from adapting to change; access to traditional knowledge is important. Community leaders and others who are trained from a very young age provide knowledge bank to draw from. The use of stories, ceremony, art, to convey experiences of past adaptation can inspire and inform adaptation to changes today, and inform ecological restoration.	2006) (Senos et al. 2006) (Turner 2014)
Participatory planning approaches	Urban and regional planning for resilience related to changing hydrological systems and risk assessments	Key Methods: Mixed methods: interviews, a regional survey and participant observation at key regional planning events over 3 years [and] participatory action research. Planning approaches to adaptive capacity have ranged from 'participatory futures approaches' to community-based climate change adaptation (by engaging and empowering community members to be active collaborators in re-visioning and developing scenarios about their communities that facilitates co-evolutionary adaptation to climate change rather than passive adaptation. Attention to: Socio-ecological system	Strengths: Comprehensive, multiple streams of evidence, easy to triangulate evidence types. Participatory action research can foster new knowledge, learning, and action to support positive social/environmental change through reconfiguring the standard processes of knowledge production. An informal collaborative can be seen as a safe shadow space for learning more inclusive and less political that other regional forums where thinking out loud, revealing uncertainties, collectively troubleshooting and learning from neighbouring municipalities may not be doable or would be considered as inappropriate (less inclusive). Weakness: Very time consuming	Insights: Participatory vulnerability assessments can help identify adaptation strategies that are most feasible and practical in communities with a focus on risks that are already problematic; while climate stresses are reviewed along environmental and social stresses, allowing for integration and co-benefits with resource management, disaster preparedness and sustainable development initiatives. Implications & Applications: Allows for in-depth *understanding* and building of *adaptive capacity* which can serve as an effective link from assessment to action. This methodology allows to identify and address specific hazards and risks while building a	(Pelling et al. 2008) (Folke et al. 2002) (Gidley et al. 2009) (Smit and Wandel 2006) (Ballard and Belsky 2010) (Tschakert and Dietrich 2010)

		Scale of Analysis: Community (municipal), sub-regional, and regional Temporal Focus: Past (historical adaptations), present, and future		generalized capacity to address change. Study findings may inform local and metropolitan scale actions by partner organizations.	
Qualitative interview approaches	Inductive qualitative assessment within a community using local knowledge engagement. Indicators include various assets, organizations, and other supports that interviewees mentioned help or have helped them adapt to changes and their impacts.	Key Methods: Interviews and focus groups; unstructured and semi-structured interview format Attention to: Social and ecological components Scale of Analysis: Household to community Temporal Focus: Past and present impacts of change and drivers of adaptive capacity	Strengths: Gives an in-depth understanding of a community with household or individual responses to change. Builds a relationship with that community. Based on self-perception of adaptive capacity from the perspective of the community members themselves. Weakness: Very time intensive; requires community buy-in, often pre-existing relationships or understanding of the community are critical. Need to build trust to collect information.	Insights: Gain a greater range of the elements of adaptive capacity. Appreciate the nuance of limitations and opportunities at an individual or household level. Insights included: 1) types and trajectories of significant processes of change being experienced by community members, 2) the array of responses being taken to change and 3) the mechanisms that either inhibit or strengthen ability to adapt or cope with changes, including nuanced data around access to supports. Implications & Applications: Provides data for planners, decision makers, and communities on what types of policies, programs, and other supports might lead to improved adaptive capacity for groups at the local level. An increased understanding of barriers or limitations to accessing exiting supports is key to increasing successful responses across community groups.	(Bennett et al. 2015) (Knapp et al. 2014) (McCubbin et al. 2015) (Ruiz-Mallén et al. 2015)
Mixed-methods	A combination of social indicators, including	Key Methods: Mix of qualitative, quantitative and	Strengths: Nuanced understanding of the factors that lead to adaptive	Insights: Numerous insights about how to increase adaptive	(Cinner et al.

approaches	interviews, surveys, focus groups, document reviews, and Photovoice processes in order to understand flexibility and diversity, the ability to self-organize, social knowledge and learning, and access to assets.	participatory approaches. Attention to: Primarily social, as well as ability to proactively respond to ecological change. Scale of Analysis: Household, Individual community to multiple community. Temporal Focus: Present	capacity. Leads to abundant data. Differentiation of the factors that led to adaptive capacity to different changes – e.g., climate change, fisheries declines, and livelihood opportunities. Results are comprehensive, showing whether communities are able to adapt, cope or react. Produces lots of recommendations. Weakness: Very time consuming and expensive. Difficult to confirm the recommendations/outcomes with stakeholders.	capacity to different changes that are occurring. Insights into some generic actions to build adaptive capacity e.g., improving relations, gender considerations, education. Research can provide insights into which factors helped communities to adapt, cope or react to changes that are occurring. Implications & Applications: Suggests actions that communities might take for policies or programs that might be implemented at higher levels to increase community adaptive capacity. No clear path to application of the results.	2009) (McClanahan et al. 2009) (Bennett et al. 2015) (Bennett and Dearden 2013) (Cinner et al. 2015) (Marshall et al. 2010) (Marshall et al. 2013)

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