The Overlooked History in Ecomyopia Meets the Longue Durée: Print-Culture Highlights of the U.S. Southwest Seven States Colorado River Basin Compact Recontexualized by Reconstructions of Paleoclimate Based on Tree-Ring Analyses and by Disjunctures in Policy-Studies Developments

Institutional, Informational, and Career Developments	Comments
1922. The Seven State Colorado River Basin Compact is negotiated under U.S. Commerce Secretary Herbert Hoover.	In 1921 the U.S. Congress authorizes the seven Colorado River Basin States to negotiate a compact, with final congressional approval, to regulate the apportionment and use of the water of this interstate river. The delegates of the seven States reach agreement on the Compact (after several meetings and public hearings) in 1922 (Hundley 1975). The Compact creates a "rigid regulation strategy," without provisions for renegotiation in case of changes in climate or demographic conditions (Brown 1988), or new knowledge of climate variation.

1922. The U.S. Reclamation Service provides an estimate of undeveloped average annual flow of the Colorado River for Lee's Ferry (which is just below what is now the Glen Canyon Dam) of at least 16.4 million acre-ft. per year: the estimate is based on discharge records compiled during the period from 1899-1920.

The Compact negotiation sets up an artificial division of the Basin into upper and lower portions at Lee's Ferry, dividing the water of the River between them (Hundley 1975). The compact obligates the upper basin States to deliver to the lower basin 75 maf of water every ten years (an average of 7.5 maf/yr). Given the Reclamation Service's estimate of average annual flow, it appears at the time that the upper basin can easily afford to pass on that amount downstream to the lower basin (Brown 1988:283). See Hundley 1975:193) for notes on the Reclamation Service estimate for undeveloped flow at Lee's Ferry, and the ease with which the negotiating delegates accepted the Reclamation Service's "rosy forecasts" that there was sufficient water to accommodate all conceivable future requirements in the Basin (Hundley 1975: 91-92). Hundley argues that there was a strong desire to believe the government corps of engineers, to rely without question on their professional expertise in these matters, in large part to facilitate interstate cooperation.

1928. Six of the seven States ratify the Colorado River Basin Compact.	Arizona refuses to ratify the Compact out of desire to control all of the water arising from the Colorado River tributaries in that State, and fear that it would not be allocated a "fair" proportion of the water (Hundley 1975). 1928 is also the year the federal Boulder Canyon Project bill passes into law authorization of the construction of Hoover Dam.
1930s. Great Drought of the High Plains and Northern Rockies	The Dust Bowl years are not a period of extreme drought for the Colorado River Basin, although it is a relatively dry period compared to the immediately preceding two decades, and within a few years it can be seen as a harbinger of possible future water shortages for the lower basin (Hundley 1975: 297).
1944. Arizona ratifies the Colorado River Compact.	Arizona ratifies the Compact out of concerns for its rapidly declining ground water supplies and a growing electrical power shortfall (Hundley 1975:295-299).

1956. Dendroclimatological reconstructions reveal that 1905-1931 was the wettest period for the Upper Colorado River Basin (above Lake Mead) in the past 500 years, and that across the centuries severe droughts have been common in the Southwest.

Edmund Schulman (1956) publishes his results from 17 years of research, significantly supported by the University of Arizona Laboratory of Tree-Ring Research, Tucson (under the Directorship of A.E. Douglass), the U.S. Office of Naval Research, the Los Angeles Department of Water and Power, the Metropolitan Water District of Southern California, and the California Institute of Technology. (A.E. Douglass developed the master tree-ring chronology for the Pueblo area of the Southwest in the early decades of the 20th century. See his popular report in the 1929 December issue of National Geographic Magazine.)

1975. Dendrohydrological reconstructions confirm that 1905-1930 was the wettest period for the upper Colorado River Basin in the past 400 years, and provide an estimate of long-term average annual flow from upper Basin runoff.

Charles W. Stockton (1975) publishes the results of his work on the use of tree-ring data to reconstruct the annual flow of the Colorado River at Lee's Ferry for the period 1564-1961 CE. The work is part of his Ph.D. dissertation, and significantly supported by the Laboratory of Tree-Ring Research at the University of Arizona, Tucson, the U.S. Department of Interior Office of Water Resources Research, and the Lake Powell Research

Project via funds from the National Science Foundation. Stockton's work shows that there has been only one other recent wet period comparable to 1905-1930, and that was the period 1601-1621. Further, there occurred in 1565-1600 and 1870-1890 droughts for which there is no equal in the gauged record, which begins in 1896. The 1700s also saw periods of flow lower than those of the 1930s. Moreover, the average long-term flow is estimated to be ca.13 million acre-ft. per year, compared to that of 15 maf/yr for the period of the gauged record of 1896-1961.

1980. An apparent inflection point of increasing professional unease over Colorado River water policies is reached.

Brown (1988: 295-296) effectively documents that it is only in the early 1980s that the professional policy and water management community begins to systematically express heightened concern for the daunting water quantity and water quality problems faced by the Colorado River Compact States. She notes that "Oddly, relatively little action has been taken to solve these problems" (p. 296).

1982. Origins of the CBF-ISSD & CP Research Project. The suggestion develops for an interdisciplinary, interuniversity and interagency collaborative research program to anticipate various impacts of a severe, multiyear drought in the southwestern United States, and to assess alternative policy responses to such a drought for the Colorado River basin.

Young (1995: 779) recounts that this suggestion "arose at a conference sponsored by the Arid and Semi-Arid Lands Directorate of the Man and the Biosphere Program, U.S. Department of State, held at Monterey, California, in 1982 (Engelbert and Scheuring 1984)." He notes the importance then acknowledged of the dendroclimatological reconstructions for motivating the suggested project. (This is not so apparent from the general time-is-on-our-side tone of the Engelbert and Scheuring volume, but perhaps Harold C. Fritts' pointed dendroclimatological comments, as seen there on pp. 44-49, helped spark that motivation.) Young outlines the two phase approach to the project that was developed in the 1980s, and expresses the belief that the collaborative approach and the research tools applied to this project were "unprecedented in drought research" (p. 781). In this Table of Overlooked History this program will be referred to as the Colorado Basin Futures – Impact of Severe Sustained Drought and Coping Policy Research Project (CBF-ISSD & CP Research Project).

c 1985 (?). Formation of the Environmental and Societal Impacts Group (ESIG) at the National Center for Atmospheric Research.

The mission of ESIG is apparently to promote use of climate information by policy and decision-makers to create new multi-integrated directions in societal welfare. ESIG is renamed the Institute for Study of Society and Environment (ISSE) sometime around 2000 (?), and the mission expanded to include education for the future (www.isse.ucar.edu, accessed 26 December 2012).

1988. The story of the Compact is re-told with the addition of the 1975 dendrohydrological findings of Stockton.

Brown (1988) succinctly re-tells the story of the Compact (drawing upon Hundley 1975) in a ESIG publication from a 1987 workshop on forecasting-by-analogy societal responds to regional climate change. She includes Charles W. Stockton's (1975) graph of long-term (1564-1961) reconstructed annual streamflow for Lee's Ferry (from a report by Stockton and G. C. Jacoby in the Lake Powell Research Bulletin), but no mention of Edmond Schulman's (1956) dendroclimatological data.

1990. Beginning of the second phase of the CBF-ISSD & CP Research Project. (See the 1982 entry for origins and acronym.)

Young (1995) summarizes the main components of the second phase of this research project: 1) annual hydrological and socio-economic projections for an imagined extremely severe sustained drought (SSD) for the Colorado River basin; 2) assessment of institutions "which could be used to increase capacity for preparing for and coping with" this SSD (p. 782); 3) estimating the SSD impacts on "economic sectors," "social considerations," and "the environment." These three components would be incorporated into two approaches to model responses: 1) computer optimization evaluations of alternative "policy instruments" on the economic impacts of the SSD; and 2) computer games with researchers acting as Federal and State water managers interactively playing with alternative management rules to assess different policy impacts on various Basin stakeholders in the unfolding SSD scenario.

1995. Summaries of the Phase II Report of results for the CBF-ISSD & CP Research Project are published in a special multi-authored (thirteen articles) issue of the American Water Resources Association's bulletin (Water Res. Bull. Vol. 31, No. 5, 1995).

One of the main findings of this report is that the existing decision making institutions for interstate water allocation and management of the Colorado River are designed to resolve conflicts between the Compact States, each State acting exclusively in their own self-interest. The Law of the River and the associated operating rules are not designed for discovering (long-term) collective or common interests, much less facilitating action in the common interest beyond conflict resolution (Henderson and Lord 1995: 923). The major recommendation of the report is replacing the 1922 Compact with a federal-interstate river basin compact commission, supported by a technical staff whose mission (in addition to providing accurate broadly-focused information) would be discovering common interest solutions to the basin's water management problems (Lord et al. 1995: 944). Ideally, this commission would be founded on principles of value-pluralism, creativity, flexibility, and a respect for environmental limits (Kenney 1995: 847). Its state representatives could be the State Governors, the federal representative the Secretary of the Interior, together empowered to implement decisions

spanning numerous political and bureaucratic jurisdictions (p. 848).

It remains uncertain whether such a commission would be capable of developing policy adequate to deal with a severe sustained drought of the magnitude seen in the tree-rings of the late 16th century. That was the most extreme Southwest drought period in the past 500 years, and the drought period used as the basis for an even more extreme scenario in this Phase II project report (Meko et al. 1995, Tarboton 1995; also see Stahle et al. 2000). As Krannich et al. (1995: 864) essentially point out, because such an extreme drought is beyond the scope of historical experience, the public and its water management institutions have no bases of relevant experience to build upon. Moreover, their past experiences largely reinforce a belief in the adequacy of business-as-usual. "Radical" changes in management institutions will likely occur only in emergency conditions. Kenney (1995: 848-849) notes that, as an opportunistic strategy, an extreme drought crises could serve as a powerful stimulus for institutional change. However, Tarboton's (1995) analysis can be interpreted as indicating that such an extreme drought is

unlikely to occur in the next few hundred to several thousand years.

Other findings and recommendations can be found in the several articles that make up the report. One topic that the report does not take up is the foreseeable consequences of unlimited population and economic growth for the region.

1998. A Climate Assessment for the Southwest (CLIMAS) organization is established as part of the NOAA Regional Integrated Sciences and Assessments program and housed at the University of Arizona's Institute of **THE** Environment in Tucson.

The mission of CLIMAS is to improve the ability of the Southwest to respond sufficiently and appropriately to climatic events and climate changes. It promotes participatory research for those who need information, and its investigators research climate and its consequences in the southwestern USA, including climate forcasting (www.climas.arizona.edu, accessed 26 December 2012).

2003. New dendroclimatological reconstructions confirm that 1905-1917 was the wettest period for the Southwest in the past 500 years, and that severe droughts have occurred in the Western USA each century in this 500 year record.	Fye et al. (2003) confirm, refine and extend early paleoclimatological results with work led by Edward R. Cook (one of the co-authors), some of which was published in the late 1990s. They succinctly re-tell the story of the misperceptions (or rather misconceptions) of water availability entombed in the Colorado River Compact, including references to Schulman (1956) and Stockton (1975). This work is part of a recent paleoclimate reconstruction project for the continental conterminous United States, funded by NSF and NOAA.
2004. Extended dendroclimatalogical reconstructions show that during virtually each century in the past 1200 years the Western USA experienced widespread multiyear drought.	Cook et al. (2004) show that past droughts in the Western States were especially widespread during the so-called Medieval Warm Period from ca. 900-1300 CE. This work is part of a project reconstructing the prehistoric record of North American droughts, funded by NSF and NOAA.

2006. New dendrohydrological reconstructions confirm Stockton's (1975) findings.

Woodhouse et al. (2006) confirm, refine, and extend Stockton's (1975) reconstructions for streamflow from the upper Colorado River Basin at Lee's Ferry, and provide a long-term average estimate of ca. 14.5 million acre-ft. per year for the period 1520-1961 CE. With seeming dramatic irony they report that the most recent (then on-going) drought "has been a wake-up call for many water management agencies throughout the Colorado River basin" (p. 14). They note that the underlying messages of their work are the same as those of Stockton, i.e., that the "long-term perspective provided by tree ring reconstructions points to looming conflict between water demand and supply" (p. 15), and that the reconstructions could aid in planning for natural variability. The bottom line is that "In effect, water that was not likely to be in the river on a consistent basis was divided among the basin states" (p. 1). Their work was funded by the NOAA office of Global Programs Climate Change Data and Detection program, the U.S. Geological Survey, the Wyoming Water Development Commission, and the Arizona Board of Regents Technology Research Initiative Fund

2007. The CLIMAS program enters its third phase. (See the 1998 entry for origins and acronym.)	The program's third phase is said to focus on "understanding risk, resilience, variability and change in climate and water systems, providing decision support, and facilitating knowledge exchange and partnerships" (www.climas.arizona.edu, accessed 26 December 2012). The reader can view something of their products online in their annual reports.
2008. National Geographic magazine publishes a major article on the "Drying of the West."	In text (by Robert Kunzig) and photographs (by Vincent Laforet) this February 2008 National Geographic article provides the American (and international) public with a perspective on ecomyopia meets the longue durée in the drought prone American Southwest. In the first two pages of the article's text we learn that only after recent tree-ring research has it become clear to the Colorado River Basin's water managers that the gauged climate history and streamflow data for the River do not provide an adequate appreciation of long-term water availability in the region. The article covers a number of important water management issues in this newsworthy style, and brings in future climate change, along with the ghost of Mesa Verde and the Anasazi.

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