CHAPTER 2 BASINS AT RISK: WATER EVENT DATABASE METHODOLOGY

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Submitted for publication, as part of set of three articles, to *Water Policy*, World Water Council, October 1, 2001, 47 pages, in review.

KEYWORDS

Event Data, International Rivers, Water Conflict, Cooperation, Quantitative Analysis

ABSTRACT

To better understand conflict and cooperation over international freshwater resources, we created a database of historical incidents of international water cooperation and conflict spanning the years 1948 to 1999. These incidents were ranked by intensity using precise definitions of conflict and cooperation and linked to the international basin in which they occurred. This research is part of the Basins at Risk (BAR) project and was conducted under the auspices of the Transboundary Freshwater Dispute Database, Oregon State University. The purpose of this paper is to describe the process by which data were collected and coded and to highlight some summary findings. This water event database represents a unique resource that allows exploration of relationships between historical incidents of water conflict and cooperation and a wide range of biophysical, socioeconomic, and political data. Initial summaries of the data indicate that international water relations over the past fifty years have been overwhelmingly cooperative, belying claims that water is mainly a source of international conflict. Cooperative water relations concern a wide range of issue areas, including water quantity, infrastructure, joint management, and hydropower. Conflict over water tends to center on quantity- and infrastructure- (e.g., dams) related concerns.

INTRODUCTION

In the policy literature and popular press, issues of water and international conflict have been linked with increasing frequency (Westing 1986; Elliott 1991; Gleick 1993; Homer-Dixon 1994; Remans 1995; Butts 1997; Elhance 1999). Yet despite the number

of case studies analyzing and comparing water-related conflict in various international river basins, little quantitative, global-scale evidence has been compiled. Existing work often consists of case studies from the most volatile basins and excludes examination of cooperation, spatial variability and precise definitions of conflict. The purpose of the Basins at Risk project is to identify historical indicators of international freshwater conflict and, from these indicators, create a framework with which international river basins at potential risk for future freshwater conflict may be identified and further evaluated.[3]

This chapter describes one component of the Basins At Risk (BAR) project – the creation of an event database documenting historical water relations. The goal in creating this database was to identify all reported instances of conflict or cooperation over international freshwater resources for the entire world for the past fifty years, to classify those events by the international river basin in which they occurred, the countries involved in the event, the date, level of intensity of conflict or cooperation, and the main issue associated with each event. All the event information collected and coded was compiled in a relational database to allow for analyses at an array of spatial and temporal scales.

There are two reasons for providing such detailed descriptions of the data sources and methodologies behind the creation of the BAR Water-Event Database. The first is that the findings of the Basins At Risk Project are grounded in this database. For this reason, this chapter is as explicit as possible about how the event data were obtained and coded, in order to facilitate any evaluations of the project's findings. The second is to offer a possible model for those interested in following a similar research methodology for other issues or resources.

For the purposes of the Basins At Risk Project, water events are defined as instances of conflict and cooperation that occur within an international river basin, that involve the nations riparian to that basin,[4] and that concern freshwater as a scarce or

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[3] For results of the project, see Chapter 4.

[4] In incidents involving a country that is a topographic, but not functional, riparian (i.e., the country's territorial share of a basin does not regularly contribute water to that basin), the country is not treated as riparian, and so that incident would not be considered an event. An exception to this rule are situations in

consumable resource (e.g., water quality, water quantity) or as a quantity to be managed (e.g., flooding or flood control, managing water levels for navigational purposes). Incidents that did not meet the above criteria were not included as events in the analyses (e.g., third-party (i.e., non-basin country) involvement, delineation of rivers as boundaries, fisheries, issues internal to a country, construction of ports or waterfront facilities).[5] The time period covered by the event database, 1948-1999, was chosen for its relevance to potential future instances of cooperation and conflict and for data manageability and availability. The spatial coverage is global and concerns all international river basins.

To locate event data information, a multi-step approach was used. We searched multiple existing political science datasets and conducted primary searches of several electronically-searchable news databases. Both approaches were necessary, as we found little overlap between events in the political science databases and information obtained from primary news sources. Moreover, while the earliest electronically-searchable news sources begin with 1978 information, some of the political science datasets provided event information as far back as 1948, facilitating the incorporation of earlier decades into the Event Database. In addition, we incorporated information from historical analyses and case studies of international river basins.

EVENT DATA

A number of political science datasets exist that document interactions among countries. These "event data" are widely used in quantitative political science analyses. Originally developed by Charles McClelland in the early 1960's, event data serve as a bridge from traditional diplomatic history to quantitative analyses of international

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which the country acts as a riparian, such as Egypt in the Jordan River basin during the course of the Huleh Swamp drainage dispute.

[5] Other examples of incidents that were not included as events in the BAR database (unless they concerned water as a scarce, consumable and/or manageable resource) include: incidents concerning foreign aid; water as a weapon/victim/target of warfare; navigation; creation of free trade zones in border river areas; territorial disputes (e.g., control over river islands); water supplies or water purification equipment for refugees; and, purchasing and selling of hydroelectricity.

politics. Unlike traditional foreign policy studies, which primarily use documents, histories, memoirs and other narrative sources, event data allow analysis in a statistical framework. As stated by Schrodt:

> Event data are generated by examining thousands of newspaper reports on the day to day interactions of nation-states and assigning each reported interaction a numerical score or a categorical code. … When these reports are averaged over time, they provide a rough indication of the level of cooperation and conflict between two states (Schrodt 1993 1).

Many of the existing event datasets were created under the Data Development for International Research (DDIR) project, which was funded by the National Science Foundation in the late 1980's and early 1990's. The goal of the DDIR was to provide empirical data that would facilitate understanding and predicting of international conflict (Merritt, Muncaster, & Zinnes 1993). Datasets produced under the DDIR project's auspices are available to the public through the Inter-University Consortium for Political and Social Research (ICPSR), at website: http://www.icpsr.umich.edu/. Event data assumed a central role in studies of correlates of national and international unrest and violence and in the study of foreign policy decision-making. Event datasets cover a number of interaction types (e.g., military, political, economic) and issue areas (e.g., trade, scientific exchange, border disputes). Many of them, however, focus only on crisis events or, more specifically, on military interactions among nations, and thus do not provide any information on cooperative events. Moreover, none of the existing event datasets code specifically for water resource issues, and many are limited by the small number of countries included or the time periods covered.

One event dataset – the International Crisis Behavior Project (ICB) – provides appropriate temporal and spatial coverage, along with textual summaries, of conflictive events. Two other event datasets, however, include cooperative as well as conflictive events, contain searchable event summaries, and provide broad spatial and temporal coverage – the Conflict and Peace Data Bank (COPDAB) and the Global Event Data System (GEDS). These three event datasets contain coding that allowed us to distinguish whether an interaction between nations is related to freshwater resources. Using multiple

search criteria, we pulled relevant events from these databases and merged them into our own water-event database.

In the BAR Event database, incidents of conflict and cooperation over freshwater may be considered in two basic formats: interactions, which break out each incident by the country-pairs (dyads) and basins involved; and, events, which provides one entry for each incident in a basin, regardless of the number of country-pairs involved. Table 2.1 lists the number of events and interactions obtained from each of the datasets described here.

Table 2.1: Database Search Results

Database	*Approx. Years Covered*	*Total Records*	*Initial Search Results*	*Number of Events*	*Number of Inter-actions*
ICB	1918-1988	412	412	4	4
COPDAB	1948-1978	256,373	5,300	388	549
GEDS	1979-1994	82,778	9,500	144	225
TFDD	1874-2000	200	126	126	535
FBIS	1978-1995	n/a	1,817	439	770
WNC	1995-1999	n/a	9,589	321	629
LEXIS-NEXIS	1978-present	n/a	2,745	16	17

EVENT DATA: SOURCES AND SEARCH METHODOLOGIES

Political Science Datasets

The ICB dataset was developed by Brecher and Wilkenfeld (2000) to aid investigation of twentieth century interstate crises and the behavior of states under externally generated stress. The dataset categorizes all international crises from 1918-1988 and includes variables that describe the sources, processes, and outcomes of all military-security crises involving nation-states. Of the 412 crises identified in this dataset, Wolf (1998) found only four disputes where water was, at the least, a partial cause.

The COPDAB, created by Edward E. Azar, codes inter- and intra-state events for approximately 135 countries from the years 1948-1978 and contains 256,373 event records.[6] Event information was derived from a wide range of U.S. and foreign news sources and includes event date, initiating actor, event target, information source, issue areas, brief event description, and a numeric code assigned from a 15-point categorical scale, hereafter referred to as the COPDAB scale, ordered by the intensity of event conflict or cooperation. The dataset does not include any water-specific coding, however the brief textual summary provided a guide to identify possible water-related events. In cases where it was questionable whether or not an incident was actually water-related, we researched the original news article for clarification. Only incidents that could be positively identified as relating to water conflict or cooperation in an international basin are included in the BAR Event Database.

The COPDAB data was downloaded from the ICPSR website as a text file and imported into Microsoft Access. The database contains a summary field consisting of a brief sentence or phrase describing the event. The COPDAB data was filtered, in a series

of queries, by searching this field for the specific words or parts of words. The initial query searched for water terms (e.g., desalting, irrigation, river, dam, barrage, reservoir). Because parts of words were considered in this query, the list needed to be further filtered to delete events that included the water search terms, but were not actually water-related (e.g., Pots*dam*, fun*dam*ental, international waters, *dam*age, Sh*river*, *River*o). The resulting list was then filtered again to remove events that did not fit BAR's definition of a water event (e.g., events referring to: salt water canals, including Suez and Panama; river traffic; construction of shipping facilities; movement of troops described as being in the vicinity of rivers or lakes). Table 2.2 presents a more detailed list of the search criteria. The search results are listed in Table 2.1.

Building on the COPDAB, the GEDS Project, directed by John Davies (1998) at the University of Maryland, tracks day-to-day interactions among nation-states and other international actors using on-line news reports. The GEDS database contains 82,778 event records, covering the years 1979 to 1994. GEDS codes for the same fields as COPDAB, with some additions, including a more comprehensive event summary. The event data in the GEDS archive was derived mainly from Reuters, with some event data from BBC sources.[7] Although GEDS was not created to capture water resource issues specifically, the detailed textual summary enabled us to search for water-related events.

Similarly to COPDAB, the GEDS data was filtered by searching the Event Summary field for water-specific words or parts of words (e.g., desalting, reservoir, river, hydro). A large number of irrelevant event records were retrieved, more so than with COPDAB, because the search was conducted on a more detailed textual summary describing each event. Irrelevant records included terms such as: Amster*dam*, Fitz*water*, water canon, cold water, water-tight, *hydro*carbons, and Sa*dam*. These words were used as search terms to facilitate identification and deletion of a portion of the irrelevant records. Also deleted were records that did not fit the definition of a BAR event (e.g., river blindness, refugees crossing a border river, fish quotas, dignitaries taking tours of

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[6] Coverage is not consistent for all countries for all years. For more detailed information on the methodology associated with the creation of the COPDAB data, please refer to Azar (1993).

[7] Coverage is not consistent for all countries for all years. Additional information about the creation of the GEDS Archive, including the methodology for creation of the database and the years and countries covered, may be found on the GEDS website (http://geds.umd.edu/geds/).

lakes/rivers). Table 2.2 presents a more detailed list of the search criteria. The search results are listed in Table 2.1.

Table 2.2: Search Terms – Political Science Datasets

	COPDAB	**GEDS**
Water Terms	desalting, irrigation, lake, river, canal, pollution, dam, hydro, water, desalination, barrage, reservoir, river, cholera, swamp, wetland, delta, Aral[8]	desalting, irrigation, lake, river, canal, pollution, dam, hydro, water, desalination, barrage, reservoir, river, cholera, swamp, wetland, delta, Aral Sea
Irrelevant/ Excluded Terms	Potsdam, Rotterdam, Amsterdam, fundamental, hydrocarbons, heavy water, territorial waters, international waters, damage, driver, Khaddam, Khadam, Modderdam, Shriver, Goldwater, Sadam, Damascus, hydrogen, waterloo, Rivera, Rivero	Potsdam, Rotterdam, Amsterdam, Fitzwater, water canon, cold water, water tight, fish, underwater, watered down, Adam, fundamental, hydrocarbons, heavy water, territorial waters, international waters, waters, damage, driver, Khaddam, Khadam, Modderdam, Shriver, Goldwater, Sadam, Agdam, Damascus, hydrogen, waterloo, Rivera, Rivero
Non-BAR-Event Terms	salt water canals, including Suez and Panama; navigation, river traffic; construction of river ports or shipping facilities; border disputes or boundary settlements that happened to involve rivers; delineation of rivers as boundaries; movement of troops described as being in the vicinity of rivers or lakes; events relating to cholera or river blindness	Suez canal; Panama canal; cholera or river blindness; Palestinian autonomy along Jordan River; refugees crossing a border river; dignitaries taking tours of lakes/rivers; conflict over control of West Bank of Jordan River; water-related relief aid, including requests for water purification equipment; creation of free trade zones in border river areas; pollution of saltwater, unless freshwater specifically mentioned; fish licensing or quotas

[8] Aral was included as a search term because it represents an internal drainage for a number of large river basins.

Electronic News Databases

Although useful, existing political science datasets were not created to explore cooperation or conflict over international freshwater resources. About half of the event data compiled by BAR were gathered from news articles identified using electronically-searchable news data bases. BAR researchers conducted keyword and subject searches of these databases, identified potentially relevant news articles, obtained these articles electronically or from microfiche, and then coded and entered each article into the BAR event database. To ensure coding consistency, each article entered was double-checked by one or more BAR researchers. The electronic news databases – the Foreign Broadcast Information Service (FBIS), the World News Connection (WNC), and Lexis-Nexis – are described in further detail below.

Developed by the US Central Intelligence Agency as part of their responsibility to monitor and translate foreign news reports and government statements, the Foreign Broadcast Information Service (FBIS) contains translated broadcasts, news agency transmissions, newspapers, periodicals and government statements on political, economic, scientific and cultural issues and events from nations around the globe. FBIS articles are available through two different databases: earlier years covering 1978 to 1995 are available on microfiche and catalogued in a searchable cd-rom index of titles and subject terms for individual foreign news articles. Articles from October 1995 to the present are available through an on-line subscription to the World News Connection (www.wncfedworld.gov). An initial list of relevant articles was created by searching the keyword and title fields in the cd-rom database using a set of water terms (e.g., water resources, hydropower, etc.) and cooperation/conflict terms (e.g., dispute, war, accord, treaty), and excluded terms such as sea, navigation, or nuclear. The resulting list was then further refined by BAR researchers and used to obtain articles from microfiche. The search results are listed in Table 2.1. Table 2.3 presents a more detailed list of the search criteria.

The World News Connection (WNC), the later, on-line, electronic version of FBIS, contains full-text articles spanning October 1995 through December 1999. Although there is some overlap between FBIS and WNC in the time periods they cover,

all events entered into the BAR database were double-checked to insure that the same event was not erroneously entered multiple times. A greater number of search terms was required for the WNC searches, as compared to FBIS, because the search was conducted on textual summaries, rather than subject headings. In addition, because the WNC search engine limits search parameters to five fields, a series of three full searches were conducted, using subsets of the search parameters detailed in Table 2.3. As with FBIS, search parameters included water terms (e.g., dam, water quality, diversion), cooperation and conflict terms (e.g., secretariat, collaboration, dispute, sanction, hostility), and excluded irrelevant terms (e.g., "hold water", ocean, Rivera, oil, "Three Gorges"). The search results are listed in Table 2.1. Table 2.3 presents a more detailed list of the search criteria.

Both because FBIS coverage focuses on non-US news sources and since Central America appeared under-represented by FBIS articles, Lexis-Nexis was used to search articles for water-related events in North and Central America. The Lexis-Nexis Academic Universe is an on-line searchable database of full-text articles from a wide range of US and international news sources. Searches were conducted using the "World News" option, North/South American region and the single publication searched was the *New York Times*. The earliest year for which articles were retrieved was 1981. The sheer number of "hits" from each search made finding relevant articles difficult and, given the diversity of the subjects covered by the New York Times, much of the material retrieved had to be discarded as irrelevant. Lexis-Nexis returned up to 1,000 hits per search, so searches were narrowed by one-year intervals to limit the number of hits for each search.

The search terms used for Lexis-Nexis are the same as those described above for the WNC searches, with some additional terms excluded (e.g., Wye, New Mexico, Anthony Lake, and others), because they returned irrelevant articles. Search results were further narrowed by adding the names of all North and Central American countries, except the United States, using the 'or' Boolean operator. The relevance of the articles retrieved could usually be determined by Lexis-Nexis extended citations, although sometimes the full-text was retrieved and reviewed to determine the article's relevance.

Table 2.3: Search Terms – Electronic News Databases

	FBIS	WNC/LEXIS-NEXIS
Water Terms	water resources, hydropower, hydroelectricity, and, if not included under the heading "water resources," irrigation and river	water, river*,[9] lake, dam, stream, tributary, diversion, irrigation, pollution, water quality, flood*, drought*, channel, canal, fish (rights), hydroelect*, reservoir
Cooperation and Conflict Terms	relations, development, dispute, conflict, war, accord, negotiation, treaty, cooperation, hostility	treaty, agree*, negotiat*, resolution, commission, secretariat, joint management, basin management, peace, accord or "peace accord", settle*, cooperation, collaboration, dispute*, conflict*, disagree*, sanction*, war, troops, letter of protest, hostility, shots fired, boycott, protest*
Terms Excluded	sea or ocean or navigation or nuclear	sea, ocean, navigat*, nuclear, "water cannon", "light water reactor", "mineral water", "hold water", "cold water", "hot water", "water canister", "water tight", "water down*", "flood of refugees", Rivera, Suez, Panama, oil, drugs, "Three Gorges"

As Table 2.4 illustrates, there was a significant difference in search efficiency for the FBIS cd-rom index compared to the WNC database, specifically in terms of the number of hits returned with the initial search, the number of articles (or hits) collected, and the number of events returned from these articles.[10] In terms of search efficiency, the

[9] The * symbol allows for any possible combination of characters.

[10] Search efficiency statistics for Lexis-Nexis are not included here because of the small number of events retrieved relative to the number of articles searched.

number of hits returned per year for each database (100 for FBIS cd-rom and 1,900 for WNC), the percentage of hits actually collected due to relevancy (39% versus 10%, respectively), and the proportion of events entered relative to the initial list of returned hits (24% and 3.5%, respectively) illustrate the efficiency of searching subject terms and titles (in the FBIS cd-rom index) relative to the full-text searches provided by on-line databases (both the WNC and Lexis-Nexis). This difference is a function of the irrelevant material returned from searching for specific, water-related terms in entire articles, due to multiple uses of specific terms in the English language (e.g., in phrases such as "in hot water," "cold water reactor," "flood of refugees," etc.). Alternatively, the subject terms provided by the FBIS cd-rom index capture the main topics of each article, thereby eliminating the need to search through hundreds of topically-irrelevant hits.

Another point that is critical in terms of interpreting the analyses of the event data relates to the temporal coverage of the source databases. Comparing the hits returned to the years covered by each of the FBIS databases (see Table 2.4) exemplifies not only a difference in search efficiency, but also a difference in the degree of coverage between the two databases. The average number of events per year for each of the FBIS databases (25 for FBIS cd-rom and 80 for WNC) also demonstrates a significant difference in news coverage over the time periods captured by the two databases. While it is difficult to determine the exact reason(s) underlying these differences, such considerations are necessary so that misinterpretations of the data do not occur.

With all the sources of BAR event data, the primary data source coverage is a key influence on the temporal and spatial coverage of the event data in the BAR database. A second influential factor is the structure of the search engines and information associated with each database. Despite the advantages of electronically searchable information sources, one should also be aware of the constraints that database (and search engine) structure place on the efficiency and accuracy of searching for specific information, especially if that information was not a key component in the initial creation of the data source being mined.

Table 2.4: Search Statistics* For FBIS-CD-ROM and WNC Databases

	STATISTIC	FBIS CD-ROM (search titles & subject terms)	FBIS-WNC (full text on-line)
Initial Search	Years covered	18 years (1978-1996)	4-5 years (1996-present)
	Total hits returned	1,817 hits	9,289 hits
	Hits/year	100 hits/year	1,900 hits/year
Sort	Collected hits	>700 or ~39%	>190 or ~10%
Enter	# of BAR events	439 events	321 events
	Search efficiency (events/hits)	~24%	~3.5%
	Temporal coverage (avg. events/yr)	~25	~80

*These numbers only serve as rough estimates, as some individual articles contained multiple events.

International Freshwater Treaties

A database of water-related treaties is available through the Transboundary Freshwater Dispute Database Project (TFDD), at the Department of Geosciences, Oregon State University (Wolf 1999). The TFDD is a searchable database of summaries and/or the full text of approximately 200 water-related treaties, covering the years 1874 to 2000. Treaties in the TFDD address the fresh water needs of the signatories and, for the most part, do not include transportation, fishing, or boundary treaties. The treaties do deal with

one or more of the following issues: water rights, water allocations, water pollution, principles for equitably addressing water needs, hydropower/reservoir/flood control development, and environmental issues and the rights of riverine ecological systems. All treaties entered into the BAR event database (126 treaties from the TFDD) were coded at the same level of intensity of cooperation.

BAR EVENT DATABASE STRUCTURE

Database Components

As described earlier, a BAR water event is an instance of conflict or cooperation between nations that occurs within an international river basin, involves the countries riparian to that basin, and concerns freshwater as a scarce, consumable resource or as a quantity to be managed. These incidents of conflict and cooperation can be considered in two basic formats for the statistical analyses: "**interactions**" and "**events**". Interactions break out an incident by the each country-pair (referred to in the political science literature as a "dyad") and basin involved in that incident. The other format used in our analyses groups these interactions into single "**events**," regardless of the number of countries involved in an incident. For example, a treaty involving four countries would consist of nine sets of interactions, because there are nine possible country-pair (i.e., dyad) combinations and the interactions between the countries are considered mutual.[11] The same treaty would consist of only one event for each basin it concerned. Because the grain of our study is the international basin, an event involving multiple basins is coded for all applicable basins.

[11]Treaties and agreements are considered events in which the interaction between the parties is mutual. In other events, interactions involve initiators (those who initiate the action) and recipients (the 'target' of that action). The number of initiators and recipients in an event will influence the number of dyadic interactions associated with that event. For example, in a case involving four countries where one country initiates an action (e.g., calls for a conference) and the other three countries receive that action (e.g., are requested to attend a conference), there would only be three interactions listed for that event. Each interaction would be coded for the initiator and one of the three recipients.

The database provides great flexibility in how incidents are grouped and sorted, allowing for a wide range of questions to be asked. Each incident in the BAR database includes the following information:

- the date of the incident;
- the riparian countries involved, including whether a country initiated an action, was the target or recipient of an action, or whether the action was mutual;
- the international basin(s) with which the incident is associated;
- a summary describing the incident, including additional locational information;
- the intensity (or category) of the incident – based on the COPDAB scale of cooperation and conflict;
- the main issue area of the event (water quality, water supply/development project, hydropower, navigation, fishing, flood control, economic development, joint management, and other); and,
- the source(s) of information from which the data was compiled.

The data can therefore be sorted and grouped, for example, by interactions (country-pairs), by events, by individual countries, by basin, by geographic region, by whether a country initiated an action, was recipient of an action, or whether an action was mutual, by macro-event (e.g., a whole series of events tied to a particular theme, such as the Gabcicovo Dam dispute), and/or by the intensity of events based on an adaptation of Edward Azar's COPDAB scale. In terms of time, the temporal grain of analyses may be structured as day-to-day interactions, monthly, annual, or multiple-year averages (see Table 2.5 for example of structure of Event Database).[12]

[12] More detailed information on the structure of the event database, may be found in Appendix 1.

Table 2.5: Event Database Example

DATE	BASIN	COUNTRIES INVOLVED	BAR SCALE	EVENT SUMMARY	ISSUE TYPE
12/5/73	LaPlata	Argentina-Paraguay	4	PRY AND ARG AGREE TO BUILD 1B DAM, HYDROELECTRIC PROJECT	Infrastructure
1/1/76	Ganges	Bangladesh-India-United Nations	-2	Bangladesh lodges formal protest against India with United Nations, which adopts consensus statement encouraging parties to meet urgently, at level of minister, to arrive at settlement.	Quantity
7/3/78	Amazon	Bolivia-Brazil-Colombia-Ecuador-Guyana-Peru-Suriname-Venezuela	6	Treaty for Amazonian Cooperation	Economic Development
4/7/95	Jordan	Israel-Jordan	4	Pipeline from Israel storage at Beit Zera to Abdullah Canal (East Ghor Canal) begins delivering water stipulated in Treaty (20 mcm summer, 10 mcm winter). The 10 mcm replaces the 10 mcm of desalinated water stipulated Annex II, Article 2d until desalinization plant complete.	Quantity
6/1/99	Senegal	Mali-Mauritania	-3	13 people died in communal clashes in 6/99 along border between Maur. & Mali; conflict started when herdsmen in Missira-Samoura village in w. Mali refused Maur. horseman use of watering hole; horseman returned w/ clansmen, attacking village on 6/20/99, causing 2 deaths; in following retaliation 11 more died.	Quantity

Categorizing the Intensity of International Cooperation and Conflict

Edward Azar's Conflict and Peace Databank (COPDAB) International Cooperation and Conflict Scale categorizes events in terms of the nature and intensity of conflict or cooperation. The COPDAB Scale provides a measure of the international conflict/cooperation intensity for individual nations and between pairs of nations over time periods ranging from single days to multiple years. Azar's interest was in "studying the characteristics of cooperation and … conflict between and within nations … and in tracing the relationships between these characteristics and other traits and behaviors of nations in … international systems" (Azar 1993). To assess an event's intensity of cooperation or conflict, the COPDAB scale was created to allow for grouping of events by intensity and nature, so that they might be dealt with as a class. The COPDAB scale differentiates categories of conflict and cooperation by an arbitrary set of numbers ranging from level 1, representing the most cooperative events, to level 15, representing the most conflictive events. Level 8 represents neutral events. To make the COPDAB scale more intuitive, we first inverted it and then shifted it along the number line so that neutral events were centered on zero. The BAR project's basic scale then ranges from –7 to +7, with –7 denoting the most conflictive events, 0 denoting neutral events, and + 7 denoting the most cooperative events. Other modifications made to the COPDAB scale include the addition of water terms (listed in italics in Table 2.6) specific to BAR events, and a new category, "formal declaration of war." To accommodate this category, which is not part of the original COPDAB Scale but which is relevant to BAR, category 13 (Small scale military acts) and 14 (Limited war acts) were merged into one category, number 13. Category 14 was given the heading and description of category 15 (Extensive war acts causing deaths, dislocation or high strategic costs), and Category 15 was changed to indicate a formal declaration of war.

The primary utility of the scale component in the database would seem to be in categorical analyses of event occurrences, for example in counts of the number of wars that have occurred within a particular timeframe or the number of treaties into which a particular pair of countries have entered. Calculations of average scale values by year,

country, etc., beyond mere classification, would seem to be proscribed due to the categorical nature of the scaling system, as well as the arbitrary numerical values assigned the various classes. However, the categorization system is logically ordered with increasingly negative or positive categories of events assigned smaller or larger numeric values. With this ordering, it seems reasonable that information, even if imperfect, can in fact be derived from data summaries involving averages of scale values across event categories (again, for example, average values by year, country, etc.). In essence, this summarizing of information involves acceptance of the notion that the *ordinal* categorization of events can also be treated in principal as a *cardinal* system (Yoffe and Giordano 2001).

Given this notion, the problem becomes one of determining if the numeric spacing between category values assigned in our scaling system is appropriate. In other words, it must be determined if the difference between event categories 1 and 2 should be the same, in terms of intensity differential, as the difference between event categories 6 and 7 (the absolute difference being one in each case; the percentage differences being 100% and 17% respectively). It is our contention that the distance between any two events should increase as the intensity associated with those events increases. That is to say, the cardinal difference between event categories 6 and 7 should be greater than the difference between event categories 1 and 2, because, intuitively, the difference between the signing of a treaty and unification into one nation (categories 6 and 7) is far more significant than the difference between mild verbal support and official verbal support (categories 1 and 2). Therefore, for statistical analysis purposes, each event value was converted to its anti-logged equivalent so that the distance (or intensity) between values at the extremes of the scale is greater that the distance between values at the middle of the scale. Table 2.6 illustrates the correspondence between the original COPDAB scale, the revised (BAR) scale, and its anti-logged values (Yoffe and Giordano 2001).

Table 2.6: Water Event Intensity Scale

COPDAB SCALE	RE-CENTERED (BAR) SCALE	ANTI-LOGGED, RE-CENTERED SCALE	EVENT DESCRIPTION
15	-7	-198.3	**Formal Declaration of War**
14	-6	-130.4	***Extensive War Acts causing deaths, dislocation or high strategic cost:*** Use of nuclear weapons; full scale air, naval, or land battles; invasion of territory; occupation of territory; massive bombing of civilian areas; capturing of soldiers in battle; large scale bombing of military installations; chemical or biological warfare.
13	-5	-79.4	**Small scale military acts:** Limited air, sea, or border skirmishes; border police acts; annexing territory already occupied; seizing material of target country; imposing blockades; assassinating leaders of target country; material support of subversive activities against target country.
12	-4	-43.3	**Political-military hostile actions:** Inciting riots or rebellions (training or financial aid for rebellions); encouraging guerilla activities against target country; limited and sporadic terrorist actions; kidnapping or torturing foreign citizens or prisoners of war; giving sanctuary to terrorists; breaking diplomatic relations; attacking diplomats or embassies; expelling military advisors; executing alleged spies; nationalizing companies without compensation.
11	-3	-19.8	**Diplomatic-economic hostile actions:** Increasing troop mobilization; boycotts; imposing economic sanctions; hindering movement on land, waterways, or in the air; embargoing goods; refusing mutual trade rights; closing borders and blocking free communication; manipulating trade or currency to cause economic problems; halting aid; granting sanctuary to opposition leaders; mobilizing hostile demonstrations against target country; refusing to support foreign military allies; recalling ambassador for emergency consultations regarding target country; refusing visas to other nationals or restricting movement in country; expelling or arresting nationals or press; spying on foreign government officials; terminating major agreements. *Unilateral construction of water projects against another country's protests; reducing flow of water to another country, abrogation of a water agreement.*

Table 2.6: Water Event Intensity Scale (cont.)

COPDAB SCALE	RE-CENTERED (BAR) SCALE	ANTI-LOGGED, RE-CENTERED SCALE	EVENT DESCRIPTION
10	-2	-6.6	**Strong verbal expressions displaying hostility in interaction:** Warning retaliation for acts; making threatening demands and accusations; condemning strongly specific actions or policies; denouncing leaders, system, or ideology; postponing heads of state visits; refusing participation in meetings or summits; leveling strong propaganda attacks; denying support; blocking or vetoing policy or proposals in the UN or other international bodies. *Official interactions only.*
9	-1	-1.0	**Mild verbal expressions displaying discord in interaction:** Low key objection to policies or behavior; communicating dissatisfaction through third party; failing to reach an agreement; refusing protest note; denying accusations; objecting to explanation of goals, position, etc.; requesting change in policy. *Both unofficial and official, including diplomatic notes of protest.*
8	0	0.0	**Neutral or non-significant acts for the inter-nation situation:** Rhetorical policy statements; non-consequential news items; non-governmental visitors; indifference statements; compensating for nationalized enterprises or private property; no comment statements.
7	1	1.0	**Minor official exchanges, talks or policy expressions--mild verbal support:** Meeting of high officials; conferring on problems of mutual interest; visit by lower officials for talks; issuing joint communiqués; appointing ambassadors; announcing cease-fires; non-governmental exchanges; proposing talks; public non-governmental support of regime; exchanging prisoners of war; requesting support for policy; stating or explaining policy.
6	2	6.6	**Official verbal support of goals, values, or regime:** Official support of policy; raising legation to embassy; reaffirming friendship; asking for help against third party; apologizing for unfavorable actions or statements; allowing entry of press correspondents; thanking or asking for aid; resuming broken diplomatic or other relations.

Table 2.6: Water Event Intensity Scale (cont.)

COPDAB SCALE	RE-CENTERED (BAR) SCALE	ANTI-LOGGED, RE-CENTERED SCALE	EVENT DESCRIPTION
5	3	19.8	**Cultural or scientific agreement or support (non-strategic):** Starting diplomatic relations; establishing technological or scientific communication; proposing or offering economic or military aid; recognizing government; visit by head of state; opening borders; conducting or enacting friendship agreements; conducting cultural or academic agreements or exchanges. *Agreements to set up cooperative working groups.*
4	4	43.3	**Non-military economic, technological or industrial agreement:** Making economic loans, grants; agreeing to economic pacts; giving industrial, cultural, or educational assistance; conducting trade agreements or granting most favored nation status; establishing common transportation or communication networks; selling industrial-technological surplus supplies; providing technical expertise; ceasing economic restrictions; repaying debts; selling non-military goods; giving disaster relief. *Legal, cooperative actions between nations that are not treaties; cooperative projects for watershed management, irrigation, poverty-alleviation.*
3	5	79.4	**Military economic or strategic support:** Selling nuclear power plants or materials; providing air, naval, or land facilities for bases; giving technical or advisory military assistance; granting military aid; sharing highly advanced technology; intervening with military support at request of government; concluding military agreements; training military personnel; joint programs and plans to initiate and pursue disarmament.
2	6	130.4	***International Freshwater Treaty;*** **Major strategic alliance (regional or international):** Fighting a war jointly; establishing a joint military command or alliance; conducting joint military maneuvers; establishing economic common market; joining or organizing international alliances; establishing joint program to raise the global quality of life.
1	7	198.3	**Voluntary unification into one nation:** Merging voluntarily into one nation (state); forming one nation with one legally binding government.

Space and Time

The geographic component is especially important to the power of the BAR Event Database. The key unit of analysis for the Basins At Risk Project is the international river basin. A river basin comprises all the land which drains through that river and its tributaries into the ocean or an internal lake or sea. An international river basin is one which includes territory of more than one country. Currently, the Earth encompasses more than 261 international river basins, covering greater than 45% of the total land area of the Earth, excluding Antarctica (Wolf, Natharius et al. 1999). Framing questions in terms of river basins offers a way to look at water issues that mitigates problems associated with the fact that most data is classified by country and fails to account for within-country variation. River basins, by providing a focus on the water resource, are a natural framework of study when considering the relationship between cooperation or conflict and freshwater resources.

Every event is linked to the basin(s), countries, and basin-country polygons with which that event is associated. A Geographic Information System (GIS) allows us to link the BAR event data with other country or basin-specific information, such as basin population, climate type, country GDP or government type, and perform statistical analyses of correlations between the event data and these other variables. The above spatial component is key because it allows us to explore the question of why a particular event occurred. The lack of such an ability has been a major criticism of the utility of event datasets in the past (Lanphier 1975; Andriole and Hopple 1984; Laurance 1990).

To incorporate both temporal and spatial variability into our analysis required the creation of an historical GIS (see Chapter 3), one which would identify spatially all the international basins that existed for each year of our study and what countries, for each year, were riparian to those basins. This historical GIS facilitated the creation of the event database by enabling us to identify whether a specific event occurred in an international basin, as many events we researched turned out to be related to intra-national, rather than international waters and as not all basins were international across the entire time period of the study. More importantly, the historical GIS allowed us to

link our incidents of international water conflict and cooperation with socioeconomic, biophysical, and political data specific to the year in which the event occurred. This linkage allowed for comprehensive spatial and parametrical statistical analyses.

The GIS of international basins provided a key spatial component, enabling us to identify whether a particular basin was international in a given year and what specific countries shared that basin. To link an event, based on information in a newspaper article, for example, we also had to identify the names of all the tributaries within each international basin. A tributary names database was created to complete this task.

This tributary database, a continuing work, involves information from multiple sources. Two initial sources of information were National Geographic and the International Commission on Large Dams (ICOLD). Through a cooperative agreement with National Geographic, the BAR project was able to make use of electronic information from their *7th Edition Atlas of the World* (Geographic 1999). Using this atlas, a BAR researcher started at the mouth of each international river basin identified by the TFDD and followed each tributary as it branched off from the main river. Each tributary name, or names, noted is linked in the database to both the basin and country in which the tributary is located. Another source of information was ICOLD's (ICOLD 1998) *World Register of Dams* database, which lists the world's large dams and includes locational information such as country, river, and nearest city. Using this location information, in addition to atlases and a wide range of web-based information, BAR researchers were able to surmise which dams lay in international basins and from that, to link the river name associated with that dam to its international basin. Eventually, it is hoped to be able to link the tributary names to their drainage networks within the BAR GIS.

SUMMARY FINDINGS

The BAR scale or index can be used to compare international conflict/cooperation levels across countries and across time and to statistically test the relationships between international conflict and cooperation and other quantifiable variables with which it is hypothesized to be causally or otherwise correlated. Even before conducting such

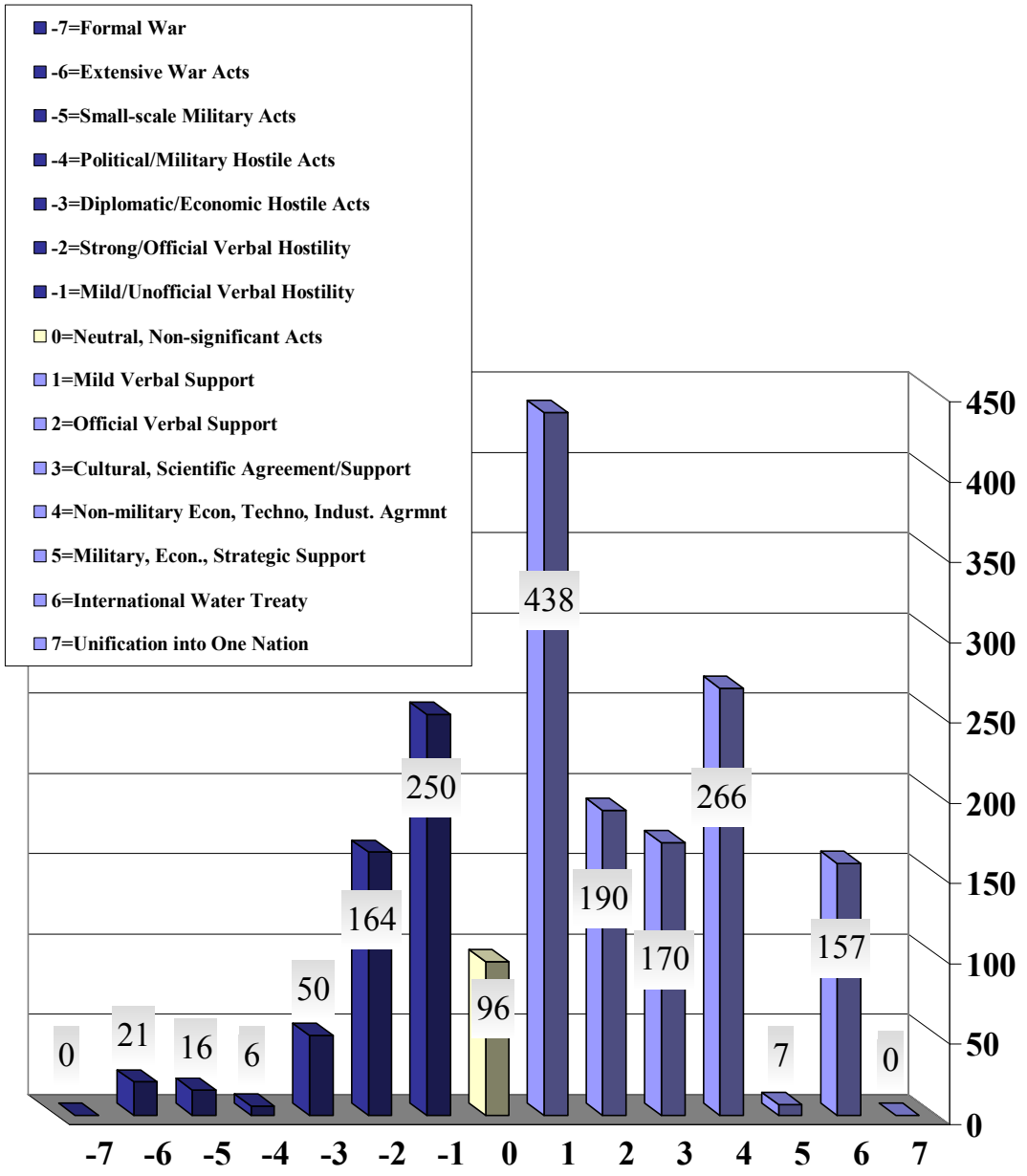
analyses, however, we can obtain a picture of international water conflict and cooperation and better understand how information in the BAR Water Event database is distributed across time and space using simple summary statistics. Incidents of conflict and cooperation over freshwater were considered in two basic formats: interactions, which break out each incident by the country-pairs (dyads) and basins involved; and, events, which provides one entry for each incident in a basin regardless of the number of country-pairs involved. The BAR Water Event database contains approximately 1,800 events, which can be broken out into approximately 3,300 country-pair interactions. The data includes events for 124 countries and 122 out of 265 current and historical international basins. Please note that data coverage is not even across all basins and countries for all years.

What was found in the BAR analyses adds new insights into understanding of conflict and cooperation over international waters and belies some of the current wisdom. The findings of BAR's summary and statistical analyses are discussed in greater depth in Chapter 4, which provides an illustration of the power and potential of the BAR Event Database.

Conflict and Cooperation

For the years 1948-1999, cooperation over water, including the signing of treaties, far outweighs overall conflict over water and violent conflict in particular. Figure 2.1 displays the total number of events by the BAR Intensity Scale, with the dark bars indicating conflictive events and the lighter bars cooperative events. The lightest bar indicates neutral events. Overall the majority of events are cooperative. Out of 1,800 events, 28% are conflictive (507 events), 67% are cooperative (1,228), and the remaining 5% are neutral. Of the total events, two thirds represent verbal interactions, either mildly conflictive or cooperative.

Figure 2.1: Total Number of Events by BAR Intensity Scale



Events involve a wide range of issue areas, in particular water quantity, infrastructure, joint management and hydropower (see Figure 2.2). Cooperative events, which are indicated by the blue portion of the bars in Figure 2.3, cover a slightly wider range of issues than conflictive events. When looking at events at the extremes of the scale, there is a more dramatic difference. Figure 2.4 shows international freshwater treaties, the most cooperative event in our data set. These treaties cover a wide range of issue areas, with emphasis on water quality and quantity, hydropower, joint management and economic development, among others. The most extremely conflictive events in our database are extensive military acts. These events concerned quantity and infrastructure exclusively (see Figure 2.5), two issue areas closely tied together.

Figure 2.2: Total Events By Issue Area

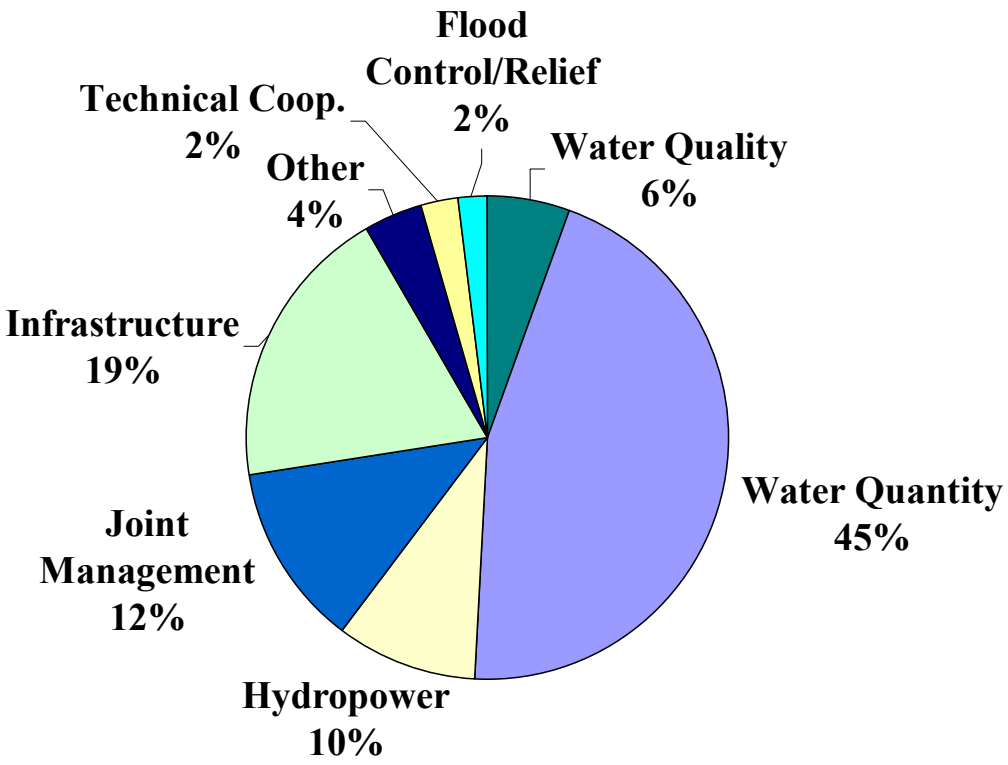


Figure 2.3: Cooperative, Conflictive and Neutral Events By Issue Area

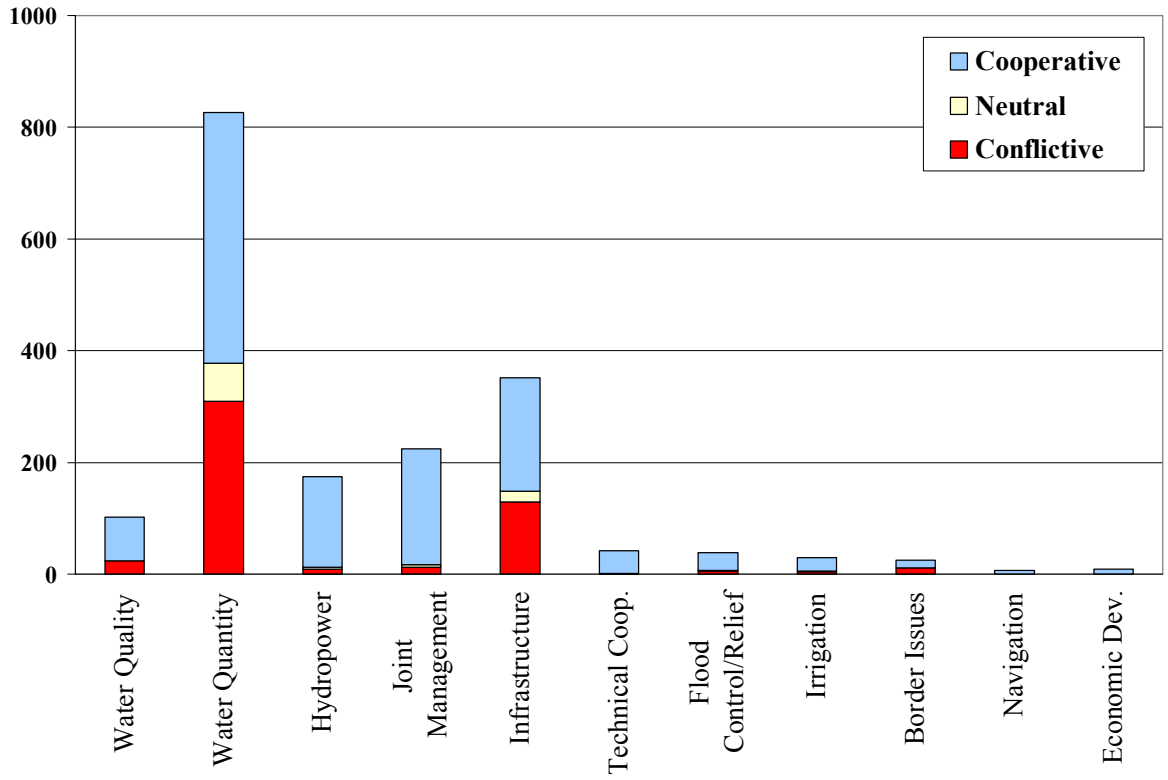


Figure 2.4: Extreme Cooperative Events By Issue Area (n= 157, BAR Scale +6)

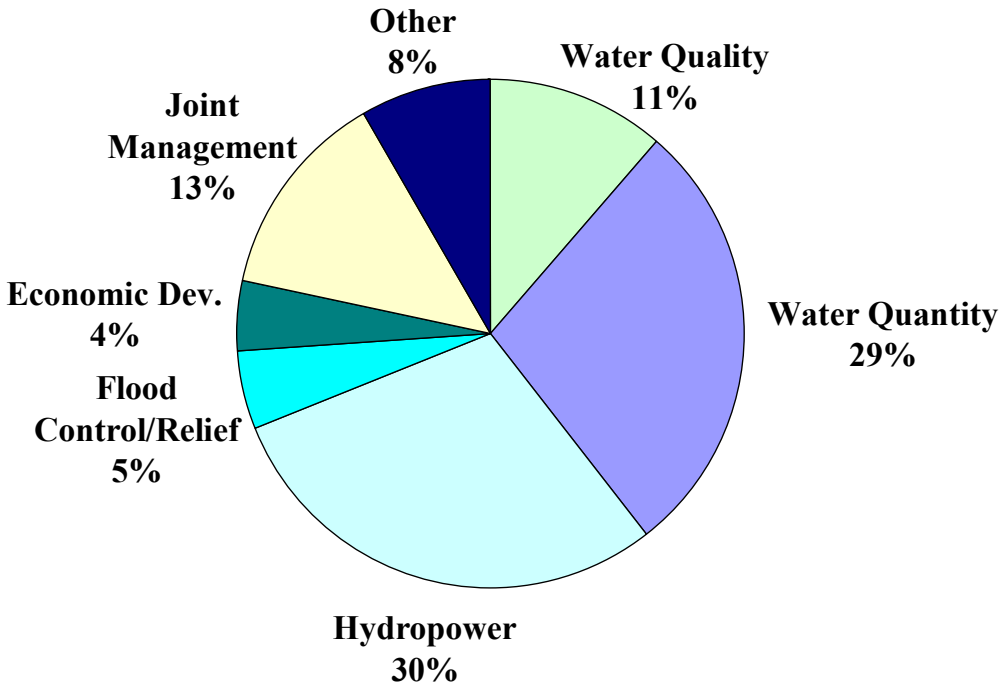
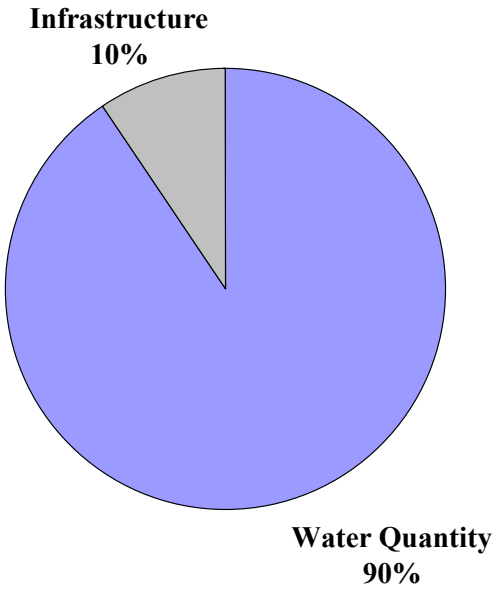


Figure 2.5: Extreme Conflictive Events By Issue Area (n=21, BAR Scale –6)



Across Time

Figure 2.6 shows the distribution of cooperative, conflictive and total events by year. Breaks in the lines indicate years for which there were no events recorded. This graph does not necessarily indicate that conflict or cooperation over water have been increasing over time. The skew towards later years in the temporal distribution reflects intensity of effort, in large part because of the availability of electronically searchable news databases, with searchable text or summaries, for the latter period of our study. The distribution may also reflect a growing importance of water, and environmental issues in general, in international news reporting.

Figure 2.7 addresses the temporal bias in the data by detailing what percent of the total events recorded for each year were cooperative. Broken down into three time periods, the graph illustrates that cooperation over water was relatively low in periods one and three, perhaps due to decolonization and the emergence of countries from the breakup of the former Soviet Union, and relatively higher in the 1970's and early 1980's. As always, it is important to keep in mind that event data for earlier periods is less comprehensive because of a relative lack of contextual information in the datasets used. A number of potential events from the COPDAB dataset are not included in these analyses because it was impossible to tell from the brief event summary whether the event concerned water specifically. Further research is required for these events, which would expand our coverage of the years 1948 to 1978.

Across Space

In terms of geographic distribution, the majority of events in our database are associated with basins in North Africa and the Middle East, Sub-Saharan Africa, and Eastern Europe – followed by Southeast and South Asia and South America (Figure 2.8). Figure 2.9, Average Bar Scale by Region, details the average BAR scale value (as an average of the average for each year, because the intensity of effort in obtaining event coverage is unequal across years), by country-region for the years 1948-1999. For each of these regions, the overall average BAR Scale is cooperative. The Middle East/North

Africa region shows the lowest level of cooperation, while Western Europe represents the highest. In terms of number of events, therefore, BAR's water event data is somewhat weighted toward the least cooperative region. Despite this bias, the majority of international relations over freshwater resources were found to be cooperative. Further detail is provided in Figure 2.10, which separates out the data by cooperative and conflictive events. Note that the regions are ordered most cooperative to least cooperative in both graphs and that the order changes slightly from Figure 2.9 to Figure 2.10.

Figure 2.6: Distribution of Cooperative, Conflictive, and Total Events By Year

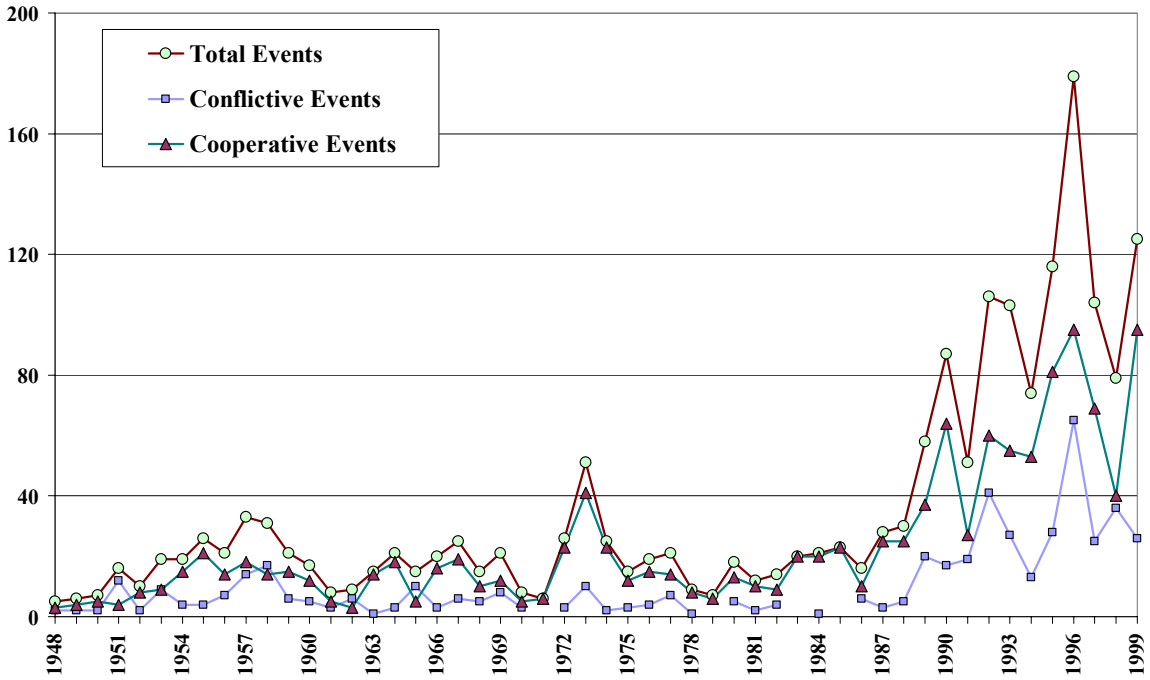


Figure 2.7: Cooperative Events as Percentage of Total Events By Year

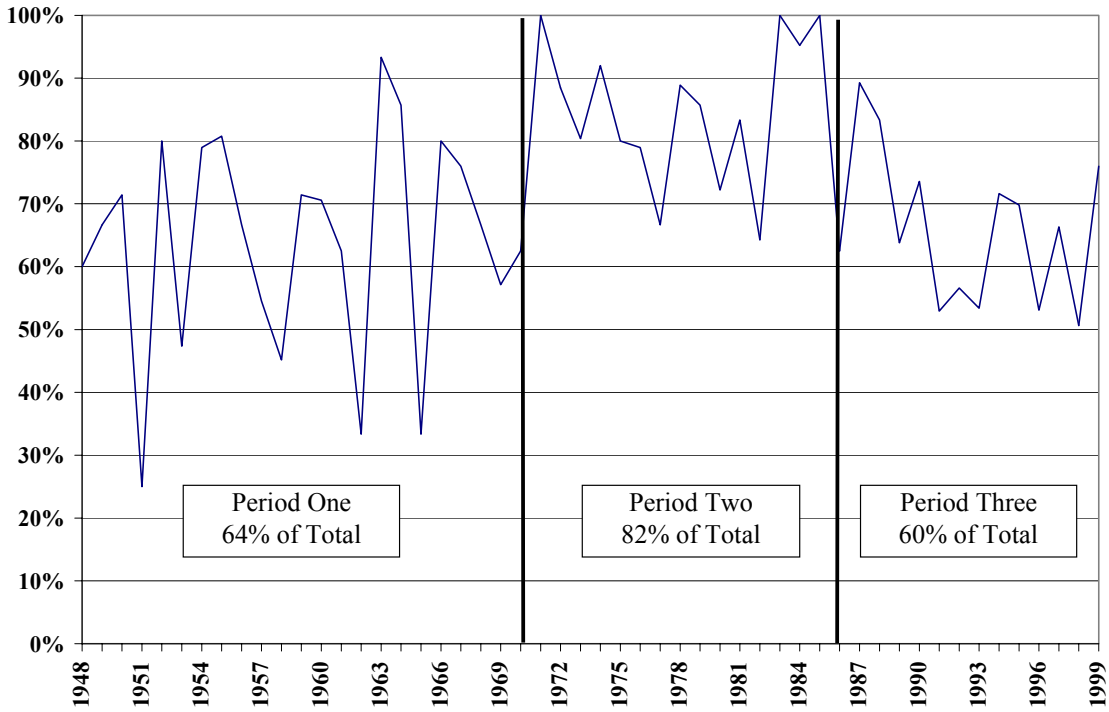


Figure 2.8: Number of Events Per Region

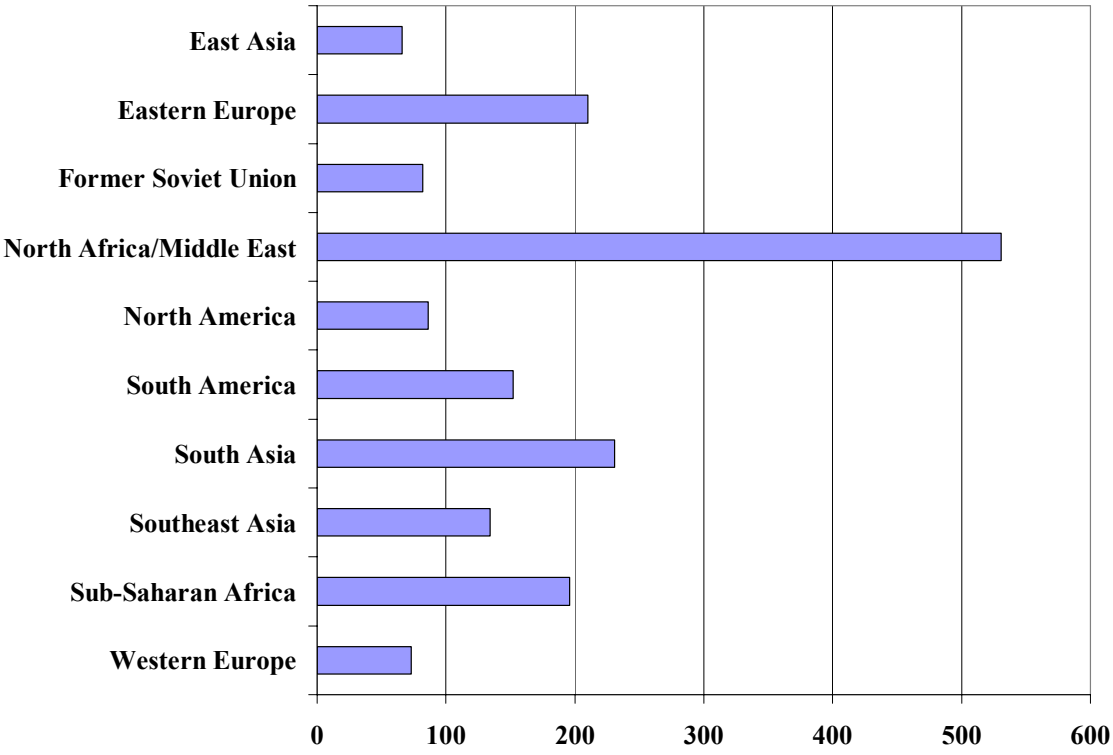


Figure 2.9: Average BAR Scale Values By Region

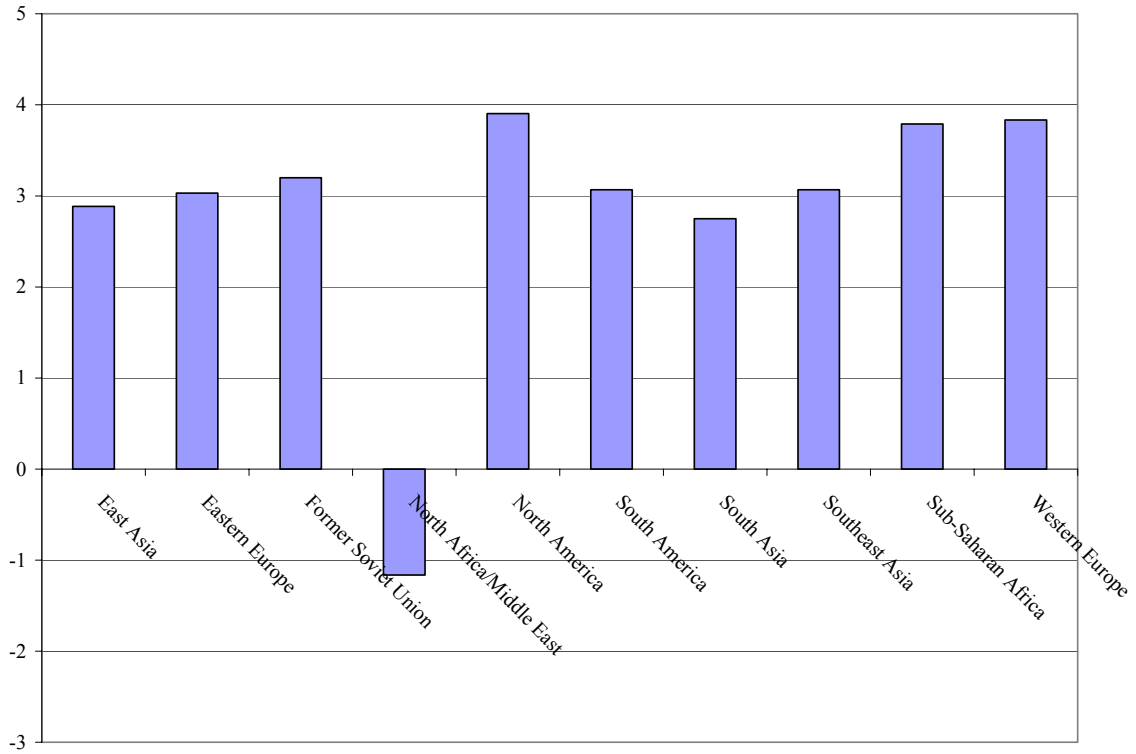
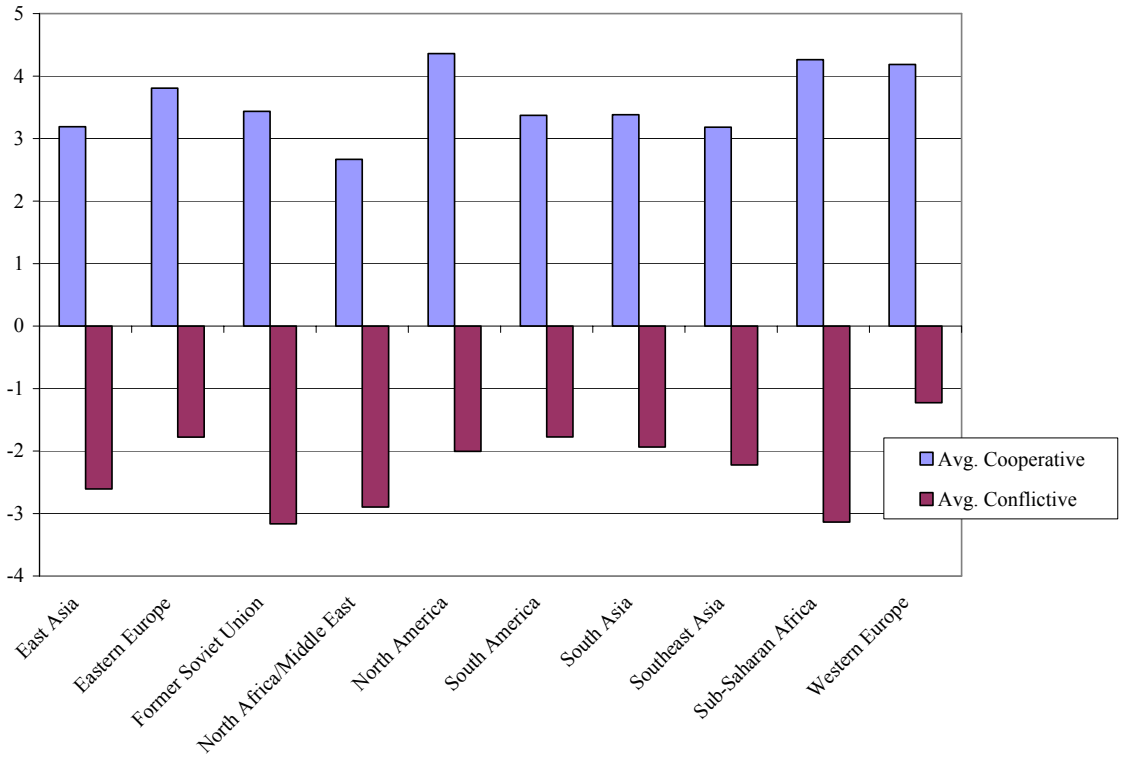


Figure 2.10: Average Cooperative and Conflictive BAR Scale Values By Region



CONCLUSION

The data above are just a sampling of the types of information that can be culled from the BAR event database. Gathered from a wide range of sources, this database represents a unique resource. It allows for analyses at multiple spatial (e.g., country, dyad, basin, region) and temporal (e.g., day, month, year, decade) scales, as well as by issue area and intensity of conflict or cooperation. When combined with other biophysical, socioeconomic, or political data, this water event database offers a powerful resource for both qualitative and quantitative, multi-scale exploration of international water issues, offering particular insights into possible drivers behind conflict or cooperation over international water. Chapter 4 discuss the results of some of this empirical research. The methodology used to create the event database could also be applied to other natural resource or other issues, especially if interest lies with more recent events (e.g., within the last 30 years). Future research plans include more specific regional or topical research projects, expansion of the database into intra-national water events and exploring events where water was involved, but not was necessarily a driver of conflict (e.g., water as a victim, target, or tool of warfare). The BAR Event Database will be publicly available through the Transboundary Freshwater Dispute Database website (http://www.transboundarywaters.orst.edu/).

ACKNOWLEDGEMENTS

Spanning more than two years, the BAR project involved the efforts of more than 10 faculty and student researchers at Oregon State University. The authors would like to thank those researchers for their efforts and enthusiasm, especially Case Bowman, Mark Giordano, Meredith Giordano, Kyoko Matsumoto, Marc Rothgery, and Daniel Wise. In addition, the authors would like to extend their thanks to Glenda Pearson, at University of Washington Library, *National Geographic*, and the National Science Foundation Fellowship in Landscape Studies.