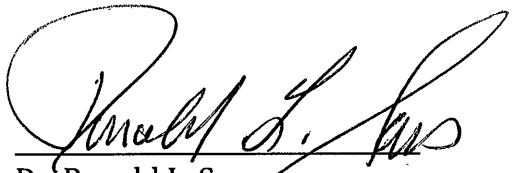
IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF TEXAS
CORPUS CHRISTI DIVISION

THE ARANSAS PROJECT,	§	
Plaintiff,	§	
	§	
v.	§	CIVIL ACTION NO. 2:10-cv-00075
	§	
BRYAN SHAW, ET AL.,	§	
Defendants.	§	

REPORT OF PLAINTIFF'S EXPERT RONALD L. SASS

July 29, 2011



Dr. Ronald L. Sass

I have been asked to provide expert testimony on behalf of the Plaintiff regarding certain aspects of the nature of the relationship between freshwater inflow into San Antonio Bay and elevated mortality within the winter resident Whooping Crane population in and around the Aransas National Wildlife Refuge and surrounding estuary and marshes.

I will present evidence supporting the contention that the seasonal incidence of abnormally high rates of mortality among the Whooping Cranes occur only during years of low freshwater inflow into the San Antonio Bay System. My testimony will encompass the inflow necessary for the vitality of the Whooping Crane and the critical time for this inflow to occur during the year. My observations and opinions in this matter are based on my education and experience, as well as information reported by others and discussed below.

To the extent allowed, I may supplement this report with additional information and opinions, particularly if additional information should be made available for my review.

I. QUALIFICATIONS, AREAS OF EXPERTISE, AND COMPENSATION

I am the Harry C. and Olga Keith Wiess Professor Emeritus of Natural Sciences in the Departments of Chemistry and Ecology and Evolutionary Biology at Rice University in Houston, Texas. I am also a Fellow in Energy and Climate Change of the James A. Baker Institute of Public Policy. My business address is 1834 Norfolk Street, Houston, Texas 77098.

I received a B.A. degree in chemistry and mathematics from Augustana College in Rock Island Illinois and a Ph.D. in Physical Chemistry from the University of Southern California. Upon receiving my Ph.D., I was awarded a post-doctoral fellowship at the Brookhaven National Laboratory in New York before accepting a position of assistant professor at Rice University in 1958. Since that time I have been a member of the faculty of the Chemistry, Biology, and Ecology and Evolutionary Biology Departments. I was chair of the Biology and then the Ecology

and Evolutionary Biology Department at Rice University from 1981 to 2005 when I took Emeritus status. I conducted research as Co-Director of the Wetland Center for Biogeochemical Research at Rice University from 1988 to 2006. I have had additional experiences as a Guggenheim Fellow of theoretical chemistry at Cambridge University and as a National Research Fellow with NASA in Virginia, Alaska, and Canada.

My career at Rice University has covered a span of over fifty years, conducting an active research program, teaching and serving the local, national and international scientific communities.

My research has covered a variety of subjects working with many undergraduates, graduate students and post-doctoral fellows. I have published over 165 papers in reviewed journals and have acted as editor and author in several books. I have taught a variety of graduate and undergraduate courses in chemistry (general chemistry, physical chemistry, quantum chemistry, x-ray diffraction), biology (introductory biology, general physiology, biophysical chemistry) and ecology (earth systems, environmental science, climate change dynamics, and environmental literature). My service work includes being a member of most of the faculty committees at Rice, Co-Director of the Center for Education (teacher training), Master of Hanszen Residential College. Nationally, I have been Chair of the Chemistry Examination for the SAT's, Chair of the international rice research team of the International Global Atmospheric Chemistry program, a member of the American Chemical Society, American Crystallographic Society and the American Geophysical Union. As a charter member and an author for the Intergovernmental Panel on Climate Change I shared in the 2007 Nobel Peace Prize awarded to the IPPC. I currently serve as a member of the Board of Trustees of the Galveston Bay Foundation and the Nature Conservancy. As a Fellow of the Baker Institute I participate in workshops, symposia and conferences on questions of science policy. I have recently published several policy papers through the Baker Institute including one on the current condition of the Whooping Crane.

While earning my B.A. degree at Augustana College I worked full time as a chemist for the Corp of Engineers developing nuclear chemical analytical methods and inventing an all-weather grease for the US Army. My graduate school research was in X-ray diffraction studies of the structures of certain chemical compounds. At Brookhaven National Laboratories, I conducted thermal neutron scattering experiments to determine nuclear spin orientations of anti-ferromagnetic materials and characterize the crystal and molecular structure of hydrogen bonding materials. During my fifty years at Rice University I conducted experiments in x-ray crystallography, Fourier transfer filtering analysis of electron micrographic images, physiology of cardiac and skeletal muscle, and calcification studies on a variety of mollusk species. The final twenty years of my active research career was the Co-Director of the Wetlands Research Laboratory at Rice and active in research in the role of a biogeochemist studying the processes characterizing wetland-generated methane as a greenhouse gas and the general properties of greenhouse gases. I am now a Professor Emeritus of Chemistry and Ecology and Evolutionary Biology at Rice University in Houston, Texas, but an active Fellow of the James A. Baker Institute for Public Policy and a faculty member of the School of Continuing Education at Rice University.

My *Curriculum Vitae* is attached as Exhibit A, and includes a list of my publications and additional details regarding my qualifications, education, and experience. I am being compensated at a rate of $ 200 per hour for time spent preparing my expert report and for any depositions or testimony.

II. INFORMATION CONSIDERED

I have considered all of the articles and other papers cited in my opinions below; these are included in the bibliography, Exhibit B. I also considered governmental reports and data on Whooping Cranes and published and unpublished academic studies and reports. In addition, I considered the water inflow data published by the Texas Water Development Board. Finally, I considered personal communication with Tom Stehn, the Whooping Crane Biologist for the U.S. Fish and Wildlife Service.

I have included exhibits that will be used to summarize or support my opinions in Exhibit A.

III. OPINIONS

A. THE WHOOPING CRANE POPULATION DEPENDS ON SUFFICIENT FRESHWATER INFLOW INTO SAN ANTONIO BAY

Estuaries are uniquely productive ecosystems where fresh water from rivers and streams meets and mingles with salt water from oceans. Estuaries are among the most biologically productive ecosystems on Earth. This productivity depends on an adequate supply of freshwater inflow to provide valuable nutrients and replenish sediments in addition to regulating the salinity of the estuary.

The Whooping Crane is a winter resident of the Aransas National Wildlife Refuge (ANWR), a part of the San Antonio Bay estuary system. This system supports a diverse population of plants and animals, many of which provide a source of food for the Whooping Crane. The primary food of the Whooping Crane is the blue crab, which ideally make up 80-90% of the Whooping Crane diet (Stehn, 2008). An individual crane can consume up to 80 crabs per day (Stehn, 2008). When crabs are not available, Whooping Cranes will switch to other foods such as clams, acorns, small fish, etc. But because of the poor nutritive value of these alternative foods, the Whooping Cranes may actually burn up fat reserves and have a net loss of energy for part of the winter (Chavez-Ramirez 1996).

Inflows carry sediments and nutrients that increase bay productivity and boost crab populations. Stehn (2010), Whooping Crane Biologist for the U. S. Fish & Wildlife Service, reported that when inflows are high, blue crabs are usually abundant. Inflows also maintain salinity levels below 23 parts per thousand (ppt) needed for marsh drinking water by Whooping Cranes (Stehn, 2010). When marsh and bay salinities become high because of insufficient freshwater inputs, Whooping Cranes are forced to make daily flights to inland freshwater sources to drink. These flights use up energy, reduce time available for foraging or resting, and could make the cranes more vulnerable to predation on the uplands.

Such factors as historical inflows, nutrient and sediment loads, circulation, and salinity patterns have been studied and compared to a fisheries analysis to determine how much water is needed to sustain the productivity of San Antonio Bay (Texas Parks & Wildlife, 1998, Canadian Wildlife Service and U. S. Fish and Wildlife Service, 2007). The annual recommended amount of freshwater inflow for San Antonio Bay is estimated to be 1.1 million acre-feet—about a third of what is available in a water abundant year (Texas Parks & Wildlife, 2007). The modeled maximum harvest freshwater inflow is slightly below the median flow of 1.5 million acre-feet annually. TPWD data suggests that water inflows greater than 1.3 million acre-feet annually result in low enough salinities in the estuary to produce high numbers of blue crabs (Texas Parks & Wildlife, 2007). In San Antonio Bay, the years with the highest harvests all had inflows greater than 3 million acre-feet. Therefore, according to Longley (1994), the salinity level should remain between 10 and 20 ppt for approximately 60 to 80 percent of the time for maximum production of the blue crab species.

B. WHOOPING CRANE MORTALITY CORRELATES WITH FRESHWATER INFLOW TO SAN ANTONIO BAY

Quantitative data are available through The Texas Water Development Board reporting the fresh water inflows into Texas estuaries. An inflow summary for the Guadalupe Estuary (San Antonio Bay) is currently available. Monthly and annual flow data beginning in 1941 are provided online (http://midgewater.twdb.state.tx.us/bays_estuaries/hydrology/guadalupesum.txt). This data represents the State's official numbers for bay inflows, and these are the numbers I relied upon in my analysis of inflow into the San Antonio Bay. Whooping Crane mortality during the winter seasons at ANWR was collected by Tom Stehn of the U.S. Fish and Wildlife Service (2009a and 2009b) and is displayed in Figure 2. These two data sets (inflows and crane mortality) overlap for the twenty-one year period from 1988 to 2009. During this period there were seven years with no Whooping Crane mortalities, five years with one death, two years with two deaths and seven years with five or more deaths.

During the years covered by these data, the Whooping Crane population wintering in Texas grew from 138 birds in 1988 to 270 birds in 2008 before dropping to 247 birds in the beginning of the year 2008/09. The actual growth of the population is shown in Figure 1. In this analysis, in order to minimize the effect of a changing population, Whooping Crane mortality is expressed as a percentage of the population at the time. The data shows a natural split in mortality as a percentage of the flock, at or below 1.1% and at or above 2.7%. The loss of 1.1% of the flock or less is considered to not be indicative of excessive stress but rather the result of random natural events. Whereas the loss of 2.7% or more of the flock may be attributed to stress levels higher than normal and possibly resulting from the effects of a low inflow of freshwater. This break is also consistent with Stehn's (2009c) analysis using 1.5% mortality of the Whooping Crane flock as the difference between low (<1.5%) and high (>1.5%) mortality.

In investigating a possible correlation between Whooping Crane mortality and freshwater inflow, a question arises as to the critical period of inflow. Various choices might be a particular period during the year preceding the arrival of the cranes, the period during which the cranes are in residence, or a combination of both. Several inflow time periods were chosen for examination. Figure 3 shows plots of mortality vs. freshwater inflow for four different time periods. All four graphs show a clear inverse relationship between mortality and freshwater inflow. The graph exhibiting the tightest correlation between mortality and inflow is for the time period of July before the arrival of the cranes through December, just after most of the birds have arrived at the wintering location. The period also includes some of the hottest months of the year when evaporation is high.

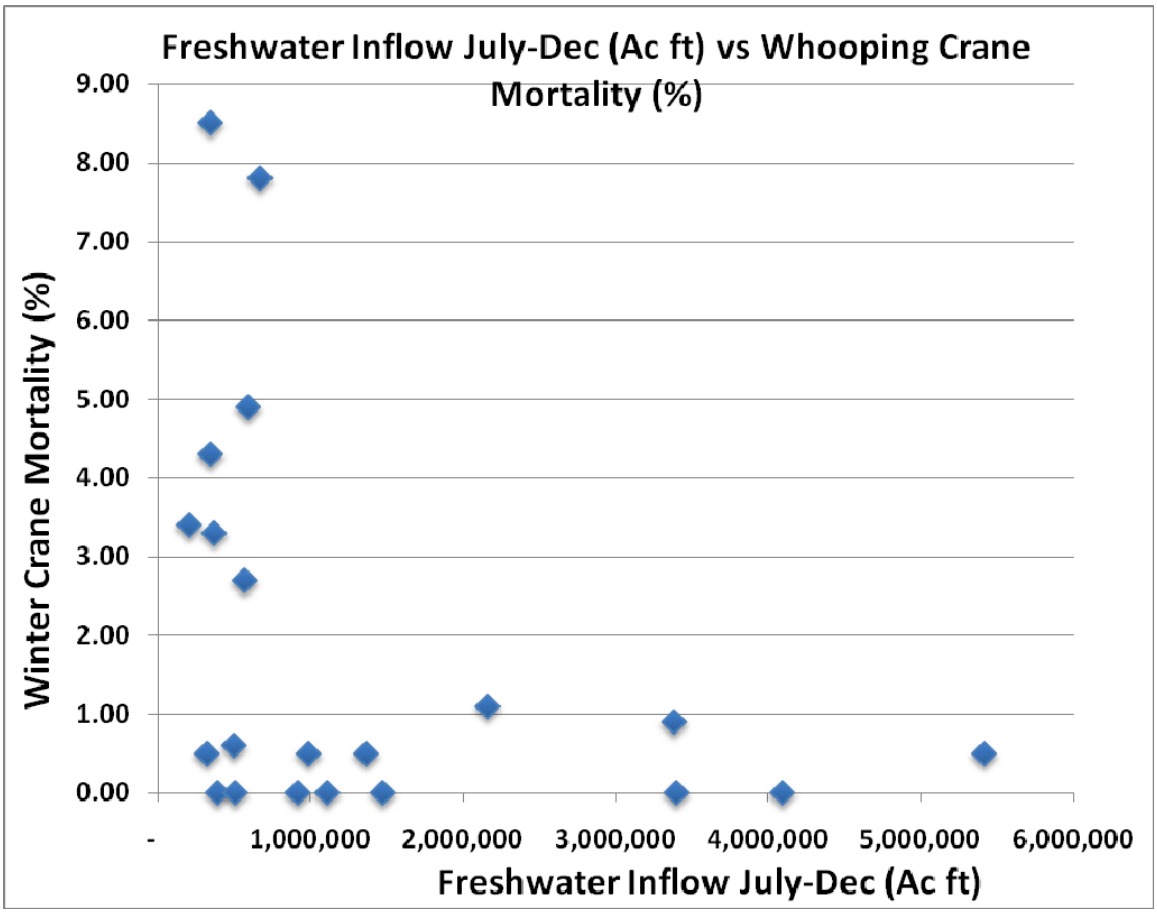


Figure 4 represents the data using this time period of inflow graphed in order of increasing inflow with corresponding mortality percentages. Two features are apparent in Figure 4. Firstly, all mortality rates equal or greater than 2.7% of the flock occur in years where the six month river flow was less than or equal to approximately 670,000 acre feet ("ac ft"). Secondly, not every year in which the flow was less than 670,000 ac ft resulted in high mortality rates. In the 11 years recorded with inflows equal to or less than 670,000 ac ft, the average winter mortality rate was 3.27 percent of the Whooping Crane population, whereas in the ten years with inflows greater than 670,000 ac ft, the average winter mortality rate was 0.35 percent of the population. The analysis indicates that a seasonal low inflow to San Antonio Bay can be stressful to the Whooping Crane population and that stress at times results in a high mortality rate.

If one hypothesizes that the critical flow is indeed 670,000-ac ft and that all excessive mortality rates fall in years with inflows less than that value, what is the probability that this postulate is indeed correct? The answers to statistical questions of this type are generally investigated by invoking the null hypothesis which states that there is no correlation between river flow and crane mortality and then showing the probability that the observed data violates the null hypothesis. For small sample sizes such as the one here, the Fisher 2 x 2 exact probability test is an accepted method. The Fisher Exact Probability Test is an excellent nonparametric technique for analyzing discrete data (either nominal or ordinal), when the two independent samples are small in size. It is used when the results from two independent random samples fall into one or the other of two mutually exclusive classes (NIST/SEMATECH e-Handbook, 2010).

With the Fisher 2 x 2 exact probability test, the probability that the observed distribution of flows and mortality divides as postulated can be calculated exactly (one tailed test). In most applications a significance level of 95% is used as the cutoff value to assert that the postulated distribution is valid. A significance level of 95% requires that the Fisher test results in a value for P of less than 0.05.

In general, the actual calculations for the Fisher test can be performed by way of a relatively simple formulaic structure. For any 2x2 contingency table, designate the cell frequencies as a, b, c, and d, and the marginal totals as a+b, c+d, etc., with N equal to the sum of the frequencies in the four cells.

a	b	a + b
c	d	c+ d
a + c	b + d	N

Given this notation, the exact probability of any particular outcome can then be calculated according to the formula

$$\mathbf{P}_{(outcome)} = \frac{(a+b)!\,(c+d)!\,(a+c)!\,(b+d)!}{N!\,a!\,b!\,c!\,d!}$$

For the particular distribution of mortality and river inflow (July to December), the Fisher matrix can be formulated as follows:

The Fisher 2 x 2 matrix specific to these data is built as follows:

a= 4 (number of years with river flow <670,000 ac ft and mortality ≤1.1%)
b = 10 (number of years with river flow >670,000 ac ft and mortality ≤1.1%)

c = 7 (number of years with river flow <670,000 ac ft and mortality ≥2.7%)

d = 0 (number of years with river flow >670,000 ac ft and mortality ≥2.7%)

(a + b) = 14

(c + d) = 7

(a + c) = 11

(b + d) = 10

N = 21

Then P = (14!7!11!10!)/(21!4!7!0!) = 0.00283[1]

and the Fisher matrix is:

Mortality (percent)	**River flow <670,000 ac ft**	**River flow >670,000 ac ft**	**Total Cases**
≤1.1	4	10	*14*
≥2.7	7	0	*7*
Total	*11*	*10*	*21*

For the particular distribution of mortality and river inflow (July to December), the probability that they are not correlated (the null hypothesis) has a P value of only 0.003. Thus the chance that mortality and river inflow are indeed correlated as

[1] Numerous online statistics calculators are available to calculate the Fisher test. I used the calculator at http://faculty.vassar.edu/lowry/webtext.html .

suggested is very highly significant. That is to say that the probability that the data are correlated is greater than 99.7%. This is quite high, much higher than the 95% confidence that is usually employed to test for significance.

The conclusion that can be drawn from these tests is that there is a strong and statistically significant relationship between inflows to San Antonio Bay and overall Whopping Crane mortality in ANWR.

V. SUMMARY CONCLUSIONS

Historically, as has been pointed out, 11 of the last 21 years had freshwater inflow, mainly from the Guadalupe-San Antonio Rivers, low enough to possibly stress the Whooping Crane. In seven of those 11 years, an excessive fraction of the birds died. The Whooping Crane is currently under threat from poor freshwater inflow into the San Antonio Bay system. The future will take all of the technological goodwill and know-how that we as humans can muster in order to stabilize or perhaps, if we are really smart, increase health and well-being of our fellow Texans, the Whooping Cranes.

Exhibit A

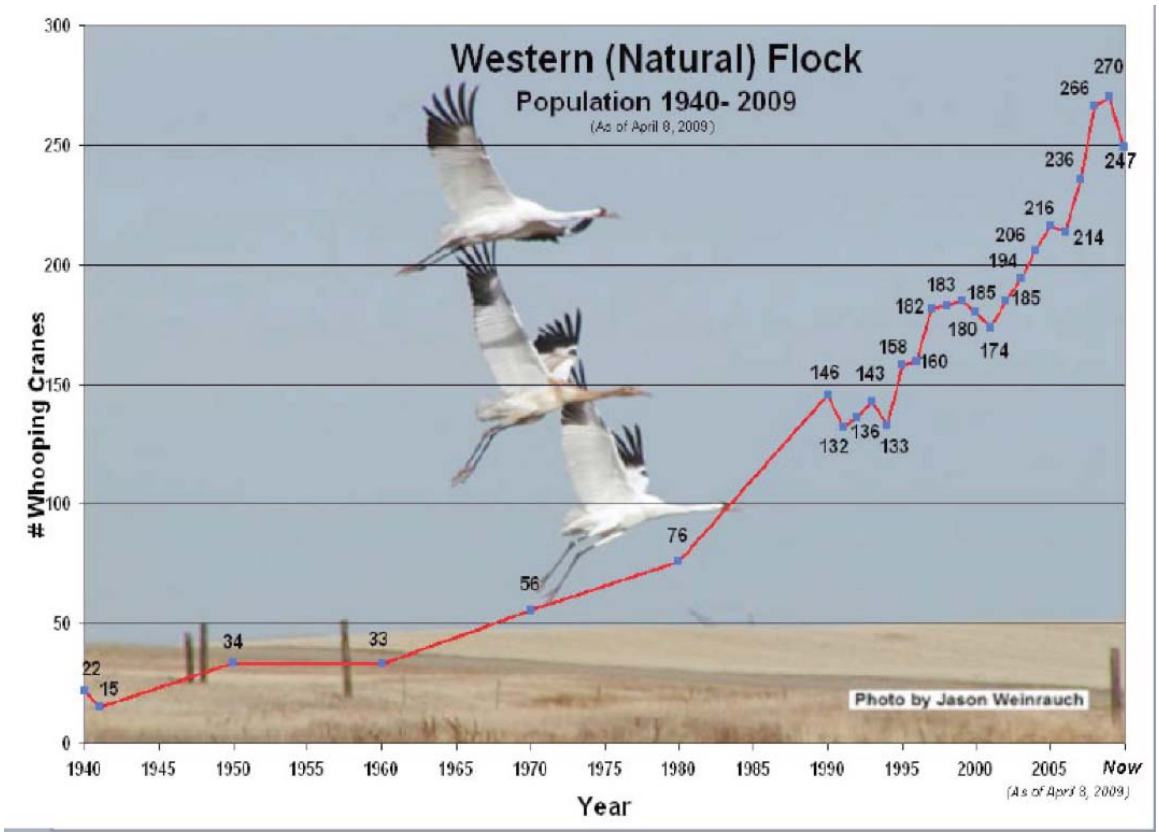


Figure 1. Annual population of the ANWR whooping crane flock from 1940 to 2009.

Year	Jul-Dec Flow (Acre feet)	Whooping Crane Winter Mortality (%)	Whooping Crane Winter Mortality (#)
1988-89	349,774	4.30	6
1989-90	209,089	3.40	5
1990-91	668,959	7.80	11
1991-92	1,479,729	0.70	1
1992-93	1,113,110	0.00	0
1993-94	598,466	4.90	7
1994-95	923,221	0.00	0
1995-96	499,553	0.60	1
1996-97	394,376	0.00	0
1997-98	1,371,562	0.50	1
1998-99	4,095,870	0.00	0
1999-00	327,744	0.50	1
2000-01	372,035	3.30	6
2001-02	2,161,718	1.10	2
2002-03	5,419,319	0.50	1
2003-04	987,272	0.50	1
2004-05	3,385,520	0.90	2
2005-06	570,863	2.70	6
2006-07	513,614	0.00	0
2007-08	3,399,637	0.00	0
2008-09	344,119	8.50	23

Figure 2. River flow and Whooping Crane winter mortality data used in this study.

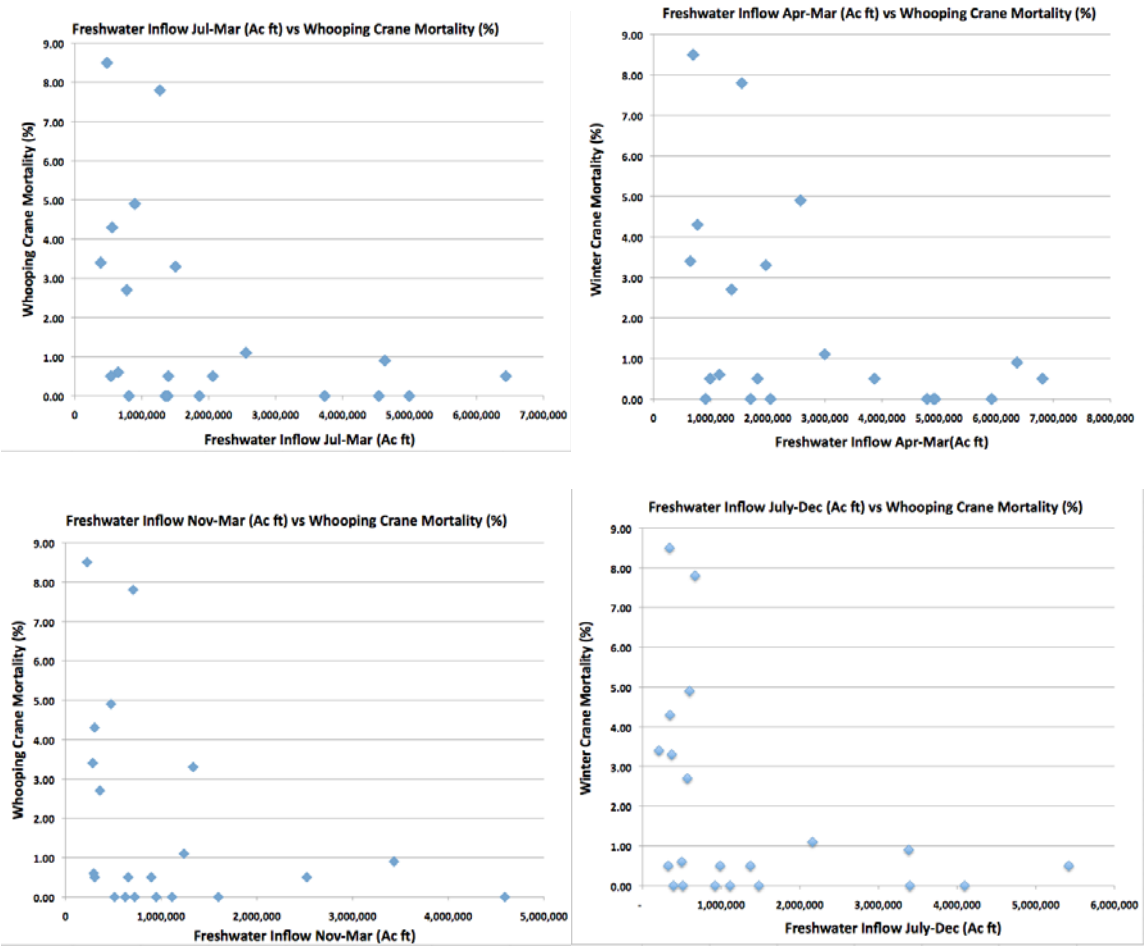


Figure 3. Graphical representation of the relationship between Whooping Crane mortality with freshwater inflow into the San Antonio Bay estuary system. The four different graphs consider four different time periods of inflow.

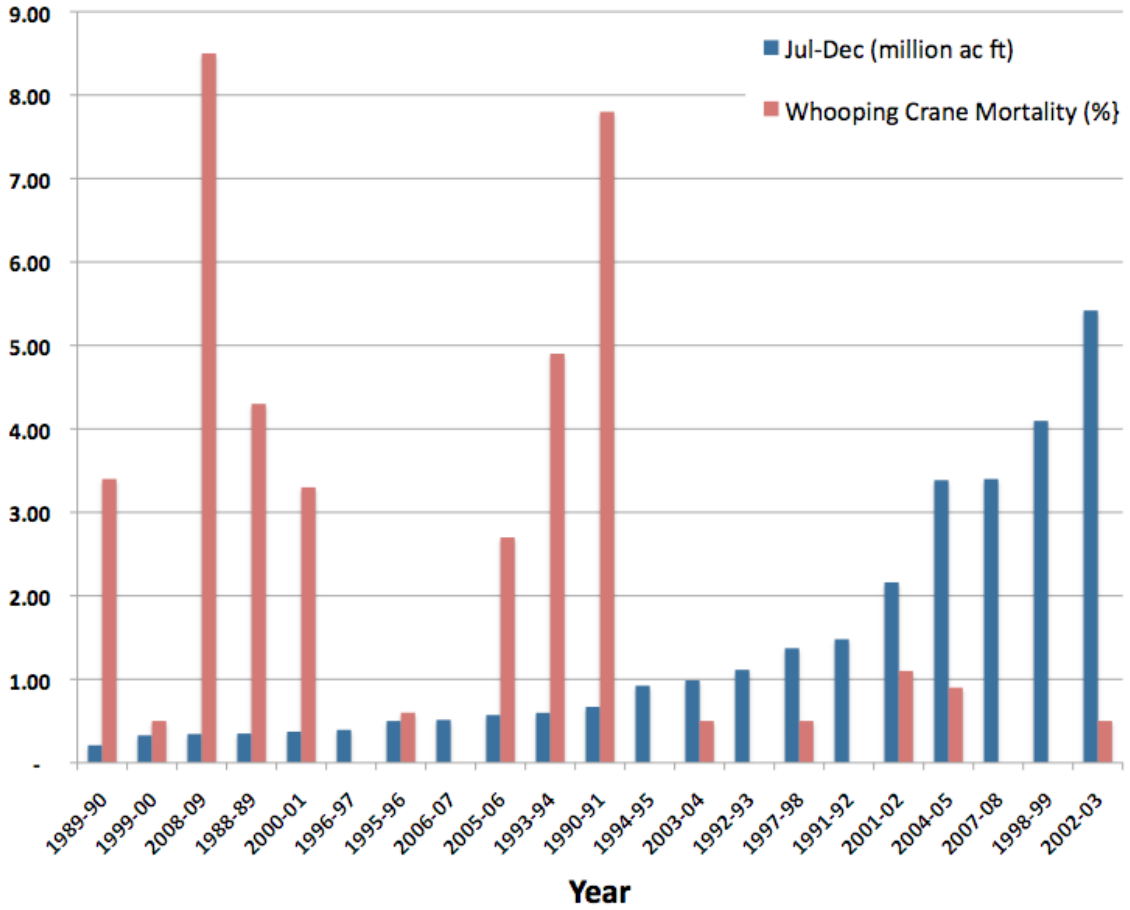


Figure 4. A bar graph Whooping Crane mortality and freshwater inflow to the San Antonio Bay. The graph is ordered in terms of increasing freshwater inflow for the period of July through December. The horizontal axis shows the year plotted and the vertical axis represents both whooping crane mortality (%) and inflow (millions of acre-feet.

Exhibit B

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Exhibit C

RONALD L. SASS

TITLE: Professor of Biology, Chemistry, and Education

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EDUCATION: University of Southern California, Ph.D. (Chemistry), 1957.
Augustana College, Rock Island, B.A. (Chemistry), 1954.

CURRENT POSITION Harry C and Olga K. Wiess Professor Emeritus of Natural Sciences, Rice University 2003-date
Consultant and Expert Witness on Environmental Matter, 2006-date
Fellow, James A. Baker Institute for Public Policy, 2003-present

EXPERIENCE:
Chair of Ecology and Evolutionary Biology, *Rice University* 1990-2003
Professor of Biology, Chemistry, and Education, *Rice University*, 1993-2003.
Visiting Professor, Nanjing Agricultural University, Nanjing, China, 2000.
Adjunct Professor, *University of New Hampshire*, 1999-present
Acting Chair of the Department of Education, *Rice University*, 1995-96.
Visiting Research Scientist, *NASA*, Langley, VA 1988-1989.
Chairman of Biology Department, *Rice University*, 1981-1987.
Adjunct Professor of Medicine, *Baylor College of Medicine*, 1977-present.
Professor of Biology and Chemistry, *Rice University*, 1975-1993.
Adjunct Professor of Biophysics, *Baylor College of Medicine*, 1974-1977.
Adjunct Professor of Biochemistry, *Baylor College of Medicine*, 1969-present.
Master, Hanszen College, *Rice University*, 1964 and 1966-1968.
Professor of Chemistry, *Rice University*, 1966-1975.
Visiting Professor of Theoretical Chemistry, *Cambridge University,* England, 1965.
Associate Professor of Chemistry, *Rice University*, 1962-1966.
Assistant Professor of Chemistry, *Rice University*, 1958-1962.
Research Fellow, *Atomic Energy Commission*, *Brookhaven National Laboratory*, Long Island, New York, 1957-1958.
Predoctoral Fellow, *National Science Foundation*, University of Southern California, 1954-1957.
Chemist, *United States Army, Rock Island Arsenal*, 1951-1954.

PROFESSIONAL ACTIVITIES

RESEARCH: Work is conducted in the Wetland Center for Biogeochemical Research at Rice University. Since 1988 this group has been studying the generation of biogenic atmospheric trace gases and the biological processes in waterlogged plant-soil environments leading to their formation. These gases, principally methane and nitrous oxide are important contributors to global climate change and major components of the chemical system responsible for stratospheric ozone depletion. Our work originally focused on projects sponsored by the National Aeronautics and Space Administration in

the tundra and boreal forest wetlands of Northern Canada and Alaska. Our current interests are in process studies of methane production and possible mitigation strategies for methane gas emissions from rice paddies and natural wetlands, the source of nearly half of all methane gas emitted annually to the global atmosphere.

Under the sponsorship of the US Department of Agriculture and the Ministry of Agriculture of the People's Republic of China. I traveled extensively in China to develop a cooperative effort between our laboratory and scientists in China for the study of gas emissions from Chinese and Indian rice paddies. This work began in May 1993 and has culminated in a joint research program with the National Agricultural University at Nanjing the Chinese Academy of Science Atmospheric Sciences Laboratory and the University of New Hampshire.

Most recently I have initiated a study of science policy issues related to global, regional, and local climate change. The first project is to consider various facets of the urban heat island effect in Houston, Texas. This work is sponsored jointly in the Rice University Center for the Study of the Environment and Culture and the James Baker Institute of Public Policy.

INTERNATIONAL ACTIVITIES

Convenor, *International Global Atmospheric Chemistry Program* Committee on Trace Gas Exchange in Rice Paddies (RICE). Committee members are scientific experts on atmospheric chemistry from the United States, Germany, Australia, Philippines, China, India, Thailand, and Japan. This committee is a part of the program in International Global Atmospheric Chemistry (IGAC) of the International Geosphere Biosphere Program (IGBP). The IGBP is part of the International Committee of Scientific Unions with the United States represented by the National Academy of Science. As part of this committees activities I am an editor for a book published by the Japanese National Institute of Agro-Environmental Sciences, which is the "Proceedings of CH_4 and N_2O Workshop" held in March,1992 at Tsukuba, Japan.

Member AGU Committee on Global Environmental Change. The purpose of this committee is to foster global environmental change science, to assure a home in AGU for all involved disciplines and individuales and, to provide scientific background for policy decisions. Global environmental change is meant to include large-scale chemical, biological, geological, and physical perturbations of
the Earth's atmosphere, oceans, land surfaces, and hydrologic cycle, with special attention to time scales of decades to centuries and to human-caused perturbations.

Consultant Embrapa Meio Ambiente (Embrapa Environment). Government of Brazil. Conduct workshops, train scientists, and set up experimental system to measure tracegas emissions from Brazilian irrigated rice fields.

Consultant Advisor on Graduate Programs, The Joint Graduate School of Energy and Environment King Mongkut' s University of Technology, Bangkok, Thailand

Member, Scientific Organization Committee, Workshop on GHG Emissions from Rice Fields in Asia, Chinese Academy of Science Soil Science Institute, Nanjing, China,

Consultant *Environmental Protection Agency* on Global Climate Change Issues in Agriculture. Activities I have participated in for the EPA have included workshops on various aspects of trace gas emissions, contributions to publications on atmospheric trace gases and mitigation of these gases from agricultural sources. I also serve as part of the oversight committee to monitor the EPA's program in the Philippines on the effects of increased carbon dioxide and ultraviolet radiation on agricultural crops in Asia.

Consultant *United Nations Development Program.* As a member of the External Advisory Committee to the International Rice Research Institute, I monitor the inter-regional research program on methane emission from rice fields in China, India, Indonesia, Philippines, and Thailand.

Lead Author *Organisation for Economic Co-operation and Development*. Co-authored the IPPC Guidelines on National Greenhouse Gas Inventories: Methane Emissions from Rice Cultivation (Reference Manualand Workbook). Also represented the OECD as an expert at the Twelfth Session of the IPCC in Mexico City, 1996.

Member, *National Science Teachers Association* Facilities Task Force. This committee addresses various questions of school science laboratory design and safety. It also keeps track of various regulations relating to laboratory use by students and helps teachers to be aware of them. The committee also publishes recommended designs for laboratory renovation and construction.

EDUCATIONAL ACTIVITIES

Co-director, Rice University Center for Education, 1988-date
The Center for Education at Rice University was established in 1988 as the administrative umbrella for a number of projects in school improvement in pre-kindergarten through twelfth grade.

The mission of the Center is to improve the education of children at all grade levels by identifying, fostering, and coordinating individual

projects to improve teaching and learning in pre-college environments in ways that cut across their usual isolation from each other.

Over the past several years, the Center Directors have developed several successful and ongoing programs in science, mathematics, writing, Asian and multicultural studies, early children's literacy, and in the relationships between Latino students, their families, and schools. These programs operate primarily in Houston and in some surrounding districts.

OTHER EDUCATIONAL ACTIVITIES

Minority Honors Pre-Med Academy Co-Director, 1988-1998.
College Board, Science Advisory Committee, Member 1989-1994.
Educational Testing Service, Chemistry Achievement Test Committee, 1988-1994
Academy of Science and Technology, Conroe, TX. Member Academy Advisory Council, 1988-1992.
National Center for Atmospheric Research, Education Effort Committee, 1988-date
Baylor College of Medicine, "Minority Research Apprentice Programs", Advisor, 1985-1987
Houston High School for the Health Professions, Science Curriculum Consultant, 1985-date
Fund for Improvement of Post-secondary Education, Consultant for the Life Sciences Program , 1984,1985
National Science Foundation Program to Train Master Teachers in Secondary Science Education, Mentor, 1983-1988
Conroe Texas Independent School District, Consultant, 1984-date.
Houston Mathematics and Science Improvement Consortium, Director, 1984,1985.

HONORS:

Rice University Gold Medal, 2007
Award Certificate from IPPC for the Nobel Peace Prize, 2007
The Texas Hall of Fame for Science, Mathematics and Technology, 2002
Meritorious Service Award, 2001, Association of Rice Alumni
Piper Professor for 1999, Piper Foundation, San Antonio, Texas
Citation for Excellence in Refereeing by the editors of the American Geophysical Union journals. 1998.
National Research Council Senior Research Fellow (NASA), 1988.
The Rice University Honor Certificate for Teaching, 1985.
The George R. Brown Prize for Superior Teaching, 1981.
The Rice University Student Association Mentor Recognition Award, 1976.
The Rice University Award of Highest Merit, 1972.
The George R. Brown Prize for Excellence in Teaching, 1967, 1969, 1970.
Salgo-Noren Distinguished Professor Award, 1966.
Guggenheim Foundation Fellowship (Cambridge University), 1965.
Senior Class Teaching Award, 1964.
Atomic Energy Commission Postdoctoral Fellowship, 1957-1958.
Sigma Xi, 1957.
Phi Lambda Upsilon, 1955.
National Science Foundation Predoctoral Fellowship, 1954-1957.
Phi Beta Kappa, 1954.

PROFESSIONAL SOCIETIES: *American Geophysical Union*
National Science Teachers Association

RECENT PRESENTATIONS,WORKSHOPS AND OTHER ACTIVITIES (1993-date):

"Process study of methane emission from rice paddies, " Jiangsu Academy of Agricultural Sciences, Nanjing, China, May 17, 1993

"A four year study of methane emission and production in Texas rice fields", Agro Environmental Protection Institute, Ministry of Agriculture, Tianjin, China, May 21, 1993.

Invited keynote address, International Symposium on Climate Change, Natural Disasters and Agricultural Strategies, Beijing Agricultural University, Beijing, China, May 26, 1993.

"Rice Cultivation and Trace Gas Exchange" (invited), Global Atmospheric Biospheric Chemistry: The first IGAC Scientific Conference, Eilat, Israel, April 18-22, 1993, with H. U. Neue.

"Options for Reducing Methane Emissions from Rice Cultivation" (invited), White House Conference on Global Climate Change, Washington D.C. June 10-11, 1993.

STELLA Model Demonstrations, Update (invited), Spring Meeting of the Cooperative University-Based Program in Earth System Science Education, Langley Research Center, Hampton, VA, June 22-23, 1993.

Methane Emission from Rice Paddy: IGAC Foci (keynote address), All Asian Workshop-Cum-Training Course on Methane Emission Studies, National Physical Laboratory, New Delhi, India, September 20-24, 1993.

"Methane Emission: Five Year Study at Rice University" (Invited), All Asian Workshop-Cum-Training Course on Methane Emission Studies, National Physical Laboratory, New Delhi, India, September 20-24, 1993.

IGAC Approach to Measurement Procedures (Invited), Federation of Asian Scientific Academies and Societies Seminar on Global Environment Chemistry, New Delhi, India, Sept. 27-Oct. 1, 1993.

"Tracegas Exchange with the Biosphere-I " (Invited), Federation of Asian Scientific Academies and Societies Seminar on Global Environment Chemistry, New Delhi, India, Sept. 27-Oct. 1, 1993.

"Methane Emission: Five Year Study at Rice University " (Invited), Regional Research Laboratory, Bhubaneswar, India, October 2, 1993.

"Methane Emission from Rice Fields in the United States" (Invited) International Symposium on Climate Change and Rie, International Rice Research Institute, Los Baños, Philippines, March 14-16, 1994.

Member, External Advisory Committee, United Nations Development Program, Interregional Research Program on Methane Emission from Rice Fields, Los Baños, Philippines, March 17-18, 1994.

Rice Cultivation and Trace Gas Exchange, CH_4 and N_2O Workshop, National Institute for Agro-Ecological Sciences, Tsukuba, Japan, March 23-25, 1994.

International Global Atmospheric Chemistry-Global Change & Terrestrial Ecosystems Task Team; Inaugural Meeting, Oxford UK, 8-9 December, 1994.

"A Multi-year Study of Methane Emissions from Texas Rice Fields, " Engineering Faculty, Tulane University, New Orleans, LA, March 10, 1995

"Methane Emission from Rice Paddies; A Process Study " (invited), International Symposium on Soil-Source and Sink of Greenhouse Gases, Institute of Soil Sciences (CAS), Nanjing, China, September 14-30, 1995.

Opportunities for Mitigation of CH4 Emissions from Agricultural Sources (invited IPCC Symposium), American Society of Agronomy Annual Meeting, St. Louis, MO, October 29-Nov 3, 1995.

Convenor, The NASA Workshop on Regional Assessment of Tracegas Emissions from Rice Fields of China, Rice University, November 7-9, 1995.

Member, External Advisory Committee, United Nations Development Program, Interregional Research Program on Methane Emission from Rice Fields, Bangkok, Thailand, November 19-25, 1995.

"The China Experience." Lecture Series, Rice University Homecoming December 1-3, 1995.

"Climate and Change." Rice University Summit of the Minds, February 3, 1996

"Global Change," Toward the 21st Century, Topics in Contemporary Science, Rice University, April 8, 1996.

"Who Will Feed Asia?" Rice University Alumni College, April 26-28, 1996.

Participant, IPCC/OECD Meeting of Experts on Emission Factors for Methane from Wetland Rice Cultivation, Bangkok, Thailand, April 30-May 2, 1996.

"Agricultural Practices and Other Factors Influencing Methane Emissions from Rice Fields" (Invited), IPCC/OECD Meeting of Experts on Emission Factors for Methane from Wetland Rice Cultivation, Bangkok, Thailand, April 30-May 2, 1996.

International Geosphere Biosphere Program Wetlands Workshop on Classification, University of California at Santa Barbara, May 16-20, 1996.

Convenor, The NASA Workshop on Regional Assessment of Tracegas Emissions from Rice Fields of China, Beijing, China, June 5-7, 1996.

Participant, Intergovernmental Panel on Climate Change Working Group I, Sixth Session, Mexico City , Mexico, September 10, 1996.

"Global Change: Are We Warming Up?", Rice University Families Weekend, October 4-5, 1996.

"Wetlands and Global Climate Change," Wetland Biogeopchemistry Institute, Louisiana State University, Baton Rouge, October 17, 1996.

"Mechanisms of Methane Emission from Flooded Agricultural Systems: A Modeling Study. Tulane University, New Orleans, April 4, 1997.

Rice Environmental Conference 1997, February 1, 1997 Panel Participant: The Scope of Technology in Environmental Protection

IGAC Science Advisory Council Meeting, Toronto, Ont., Canada, May 16-19, 1997.

IPCC Scientific Steering Committee, Expert Group on Methods for the Assessment of Country Greenhouse Gas Inventory Quality, National Institute of Public Health and the Environment, Bilthoven, Netherlands, November 5-7, 1997.

"Mechanisms of Methane Emission from Flooded Rice Fields: A Modelling Study. " Max-Planck-Institut für Terrestrische Mikrobiologie, Marburg, Germany, November 10, 1997

"Mechanisms of Methane Emission from Flooded Rice Fields: A Modelling Study. " UFZ-Centre for Environmental Research, Department of Soil Sciences, Bad Lauchstaedt, Germany, November 13, 1997.

TRAGNET Working Group to Synthesize Trace Gas Research in Managed and Natural Ecosystems. National Center for Ecological Analysis and Synthesis, Santa Barbara, California, December 2-6, 1997.

"A semi-empirical model of methane emission from irrigated rice fields." (Invited) Workshop of the Interregional Research Program on Methane Emission from Rice Fields in Beijing China, August 10-15, 1998 sponsored by the United Nations Development Programme Global Environmental Facility and the International Rice Research Institute.

"Exchange of methane and other trace gases from rice fields: a model system for wetland emission modeling." (Invited) The Ninth Symposium of the IAMAS Commission on Atmospheric Chemistry & Global Pollution (CACGP) and Fifth Scientific Conference on the International Global Atmospheric Chemistry Project (IGAC), Seattle, Washington, 19-25 August 1998.

"A semi-empirical model of methane emission from irrigated rice fields." The Ninth Symposium of the IAMAS Commission on Atmospheric Chemistry & Global Pollution (CACGP) and Fifth Scientific Conference on the International Global Atmospheric Chemistry Project (IGAC), Seattle, Washington, 19-25 August 1998.

"Methane emissions from rice fields: Effect of rice cultivars and plant height." The Ninth Symposium of the IAMAS Commission on Atmospheric Chemistry & Global Pollution (CACGP) and Fifth Scientific Conference on the International Global Atmospheric Chemistry Project (IGAC), Seattle, Washington, 19-25 August 1998.

"Global Warming and Climate Change." The Association of Rice Alumni, Alumni College, November 7, 1998. Washington, D.C.

"Agricultural Sources of Methane and Nitrous Oxide: Methane from Rice Agriculture" Invited background paper. IPCC/OECD workshop, "Good Practice in Inventory Preparation: Agricultural Sources of Methane and Nitrous Oxide." Wageningen Agricultural University (The Netherlands). February 24-26, 1999.

"Modeling Methane Emissions from Chinese Rice Paddies." Agro-Meteorological Research Center of Chinese Academy of Meteorological Sciences, Beijing, China. May 24, 1999.

"Regional and Country Level Assessment of Methane from Rice Paddies." Institute of Remote Sensing, Chinese Academy of Sciences, Beijing China, May 25, 1999.

"Factors Affecting Methane Emissions from Rice Paddies: Modeling and Remote Sensing." Institute of Natural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing, China, May 26, 1999.

"A GIS Based System for Estimating Methane Emissions from Rice Paddies." Chinese Ecological Research Network, Chinese Academy of Sciences, Beijing, China, May 27, 1999.

"Modeling Methane Emissions from Chinese Rice Paddies." Nanjing Agricultural University, Nanjing, China, May 31, 1999.

"A GIS Based System for Estimating Methane Emissions from Rice Paddies." Chinese Ecological Research Network, Institute of Agricultural Modernization and Remote Sensing, Changsha, China, June 7, 1999.

"Modeling Methane Emissions from Chinese Rice Paddies." Guangxi Academy of Agricultural Science, Nanning, China, June 9, 1999.

"A GIS Based System for Estimating Methane Emissions from Rice Paddies." Chinese Ecological Research Network Tropical Forest Station at Xi-shuang-ban-na, China, June 14, 1999.

"Monitoramento e mitigação da emissão de metano pela cultura do arroz." Invited talk to the First Brazilian Irrigated Rice Congress and the XXIII Irrigated Rice Cultivation Meeting, Pelotas, RS, Brazil, August 4, 1999.

"Modeling and Remote Sensing of Methane Emissions from Rice Paddies". Nanjing Meteorological Institute, Nanjing, China, March 25, 2000

"Global Ecosystem Dynamics", A short course, Nanjing Agricultural University, Nanjing, China, March 19-24, 2000

Session convenor: Biogeochemistry of C and N in Soils I. American Geophysical Union Spring Meeting, May 30-June 3, 2000, Washington, D. C., with S. Frolking

Session convenor: Biogeochemistry of C and N in Soils II Posters, American Geophysical Union Spring Meeting, May 30-June 3, 2000, Washington, D. C., with S. Frolking

"A Process Model of Methane Production, Oxidation and Transport in Paddy Rice Ecosystems" Invited talk, American Geophysical Union Spring Meeting, May 30-June 3, 2000, Washington, D. C., with Li, C. Zhang, Y. , Huang, Y., and Butterbach-Bahl, K

"Spatial Variability in Methane Emissions from Rice Fields", Department of Earth, Oceans, and Space, University of New Hampshire, August 16, 2000

"Spatial Variability in Methane Emissions from Rice Fields", Departments of Ecology & Evolutionary Biology and Earth Systems, University of California at Irvine, Nov. 3, 2000

"Seasonal and Spatial Variability of Methyl Halide Emissions from Rice Paddies near Houston, Texas" Fall Meeting of American Geophysical Union, December 15-19, 2000, San Francisco, California. With Redeker, K. , Andrews, J., Fisher F. and. Cicerone, R. J.

"Spatial and temporal variability in methane emissions from rice paddies: Implications for assessing regional methane budgets", Workshop on GHG Emissions from Rice Fields in Asia, Chinese Academy of Science Soil Science Laboratory, Nanjing, China, Feb. 26, 2001.

"Spatial Variability in Methane Emissions from Rice Fields", Nanjing Agricultural University, Nanjing, China, March 1, 2001.

"Spatial Variability in Methane Emissions from Rice Fields", Chinese Academy of Science, Atmospheric Science Laboratory, Beijing, China, March 8, 2001.

"Spatial Variability in Methane Emissions from Rice Fields", The Joint Graduate School of Energy and Environment King Mongkut' s University of Technology, Bangkok, Thailand, September 26, 2001.

"Remote Sensing of Methane Emissions from Rice Fields", The Thailand Research Fund, Program on Greenhouse Gas Emissions Assessment. Bangkok, Thailand, September 28, 2001

"Five lectures on Ecology and Global Change" Presented during an ecotourism trip on the Peruvian Amazon River. Sponsored by the Rice Alumni Association, October 20-28, 2001

"Can you see China from Texas", Rice's Best: Winners of Rice University's Teaching Awards 1999-2000, Rice School of Continuing Studies, November 19, 2001

"Global Measurement Standardization of Methane Emissions from Irrigated Rice Cultivation", Embrapa Meio Ambiente (Embrapa Environment), Jaguaruna, SP, Brazil, January 29, 2002.

"An Extensive Survey of Gaseous Emissions from Rice Paddy Agriculture", with Redeker, K R, Meinardi, S, :Blake, D, and Cicerone, R. American Geophysical Union, Spring meeting, Washington, DC., May 28-31, 2002

NACP Methane Workshop, Breakout session on process studies in atmospheric methane emissions, University of New Hampshire, September 10-12, 2002.

"Mitigation of Methane Emissions from Rice Fields", Non-CO2 Network Project on Agricultural Greenhouse Gas Mitigation, Environmental Protection Agency, Washington, DC, December 2-3, 2002.

"Human Response to the Subject of Global Warming" Conference on climate change at the Shell Center for Sustainability, Baker Institute, Houston, TX Sept. 14, 2004.

"Texas Coastal Marshes and Potential impact of Gulf of Mexico Oil Spills", U.S. Offshore Oil Exploration: Managing Risks to Move Forward, Baker Institute, Huston, TX, Feb. 11, 2011

"Gulf pf Mexico Currents and Fate of Spilled Oil", International Association of Drilling Contractors, Port of Spain, Trinidad, May 12-13, 2011

PUBLICATIONS:

Books:

CH_4 and N_2O Global Emissions and Controls from Rice Fields and Other Agricultural and Industrial Sources, NIAES Japan, 1994, Editors K. Minami, A. Mosier and R. L. Sass.

Journal Articles and Book Chapters:

1. Sass, R.L. and Donohue, J. (1957) The Unit Cell and Space Group of HCN Tetramer. **Acta Cryst**., 10:375.

2. Sass, R.L., Vidale, R. and Donohue, J. (1957) Interatomic Distances and Thermal Anisotropy in Sodium Nitrate and Calcite. **Acta Cryst**., 10:567-570.

3. Sass, R.L. and Donohue, J. (1958) The Crystal Structure of $S_4N_4H_4$. **Acta Cryst**., 11:497-504.

4. Sass, R.L. (1960) A Neutron Diffraction Study on the Crystal Structure of Sulfamic Acid. **Acta Cryst**., 13:320-324.

5. Hastings, J., Corliss, L., Elliott, N. and Sass, R.L. (1961) Magnetic Structure of Chromium Selenide. **Phy. Rev**., 122:1402-1406.

6. Church, J.F. and Sass, R.L. (1962) A Study of the Crystal Structure of Trimethyl cis-Cyclopropane-1,2,3-tricarboxylate. **Chem. Ind**. 1574.

7. Sass, R.L. and Scheuerman, R.F. (1962) The Crystal Structure of Sodium Bicarbonate. **Acta Cryst**., 15:77-81.

8. Strieter, F.J., Templeton, D.H., Scheuerman, R.F. and Sass, R.L. (1962) The Crystal Structure of Propionic Acid. **Acta Cryst**., 15:1233-1239.

9. Scheuerman, R. F. and Sass, R.L. (1962) The Structure of Valeric Acid. **Acta Cryst.**, 15:1244--1247.

10. Sass, R.L. and Ratner, L. (1963) Crystal Symmetry of the Dimer of Cyclobutene-1,2-dicarboxylic Acid Dimethyl Ester. **Acta Cryst**., 16:433.

11. Higgs, M.A. and Sass, R.L. (1963) The Crystal Structure of Acrylic Acid. **Acta Cryst.**, 16:657-661.

12. Brackett, E.B., Brackett, T.E. and Sass, R.L. (1963) The Crystal Structure of Barium Chloride, Barium Bromide and Barium Iodide. **J Phys. Chem**., 67:2132-2135.

13. Sass, R.L., Brackett, T.E. and Brackett, E.B. (1963) The Crystal Structure of Strontium Bromide. **J. Phys. Chem**., 67:2862-2863.

14. Sass, R.L., Brackett, E.B. and Brackett, T.E. (1963) The Crystal Structure of Lead Chloride. **J. Phys. Chem**., 67:2863.

15. Brackett, E.B., Brackett, T.E. and Sass, R.L. (1963) The Crystal Structure of Calcium Bromide. **J. Nucl. and Inorg. Chem**., 25:1295-1296.

16. Bugg, C.E., Lawson, J.B. and Sass, R.L. (1964) The Crystal Symmetry of Several Diazonium Salts. **Acta Cryst**.,17:767-768.

17. Dyke, M. and Sass, R.L. (1964) The Crystal Structure of Strontium Bromide Monohydrate. **J. Phys. Chem**., 68:3259-3262.

18. Bugg, C.E., Desiderato, R. and Sass, R.L. (1964) An X-Ray Diffraction Study of Nonplanar Carbanion Structures. **J. Am Chem. Soc**., 86:3157-3158.

19. Roth, W.R., Bang, W.B., Geobel, P., Sass, R.L., Turner, R.B. and Yu, A.P. (1964) On the Question of Homoconjugation of cis,cis,cis-1,4,7- Cyclononatriene. **J. Am. Chem. Soc**., 86:3178-3179.

20. Desiderato, R. and Sass, R.L. (1965) The Crystal Structure of Ammionium Tricyanomethide, $NH_4C(CN)_3$. **Acta Cryst**., 18:1-4.

21. Bugg, C.E. and Sass, R.L. (1965) The Crystal Structure of Pyridinium Dicyanomethylide, $C_8H_5N_3$. **Acta Cryst**., 18:591-594.

22. Kilpatrick, J.E. and Sass, R.L. (1965) Structure of the X^P Matrices in the Simple Harmoniuc Oscillator Representation. **J. Chem. Phys**., 42:2581-2586.

23. Sass, R.L. and Bugg, C.E. (1967) The Crystal Structre of Potassium p-Nitrophenyldicyanomethide. **Acta Cryst**., 23:282-288.

24. Desiderato, R. and Sass, R.L. (1967) The Crystal Structure of cis-2- Butene Episulfone. **Acta Cryst.**, 23:430-433.

25. Dyke, M. and Sass, R.L. (1968) The Crystal Structure of Dipotassium Tetranitroethide. **J. Chem. Phys**., 72:266-268.

26. Kronfeld, L.R. and Sass, R.L. (1968) The Crystal Structure of Dibenzothiophene Sulfone. **Acta Cryst.**, B24:981-982.

27. Herdklotz, J.K. and Sass, R.L. (1969) The Crystal Structure of 4-Methyl- thiomorpholine-1,1-dioxide. **Acta Cryst**., B25:1614-1620.

28. Edmonds, J., Herdklotz, J.K. and Sass, R.L. (1970) The Crystal Structure of Ammonium 1,1,2,6,7,7-Hexacyanoheptatrienide. **Acta Cryst**., B26:1355-1362.

29. Sass, R.L. and Lawson, J. (1970) The Crystal Structure of p-Sulfobenzene- diazonium Inner Salt. **Acta Cryst**., B26:1187-1189.

30. Presley, C.T. and Sass, R.L. (1970) The Crystal Structure of 2.6-Dichloro-4- Diazo- 2,5-cyclohexadien-1-one. **Acta Cryst**., B26:1195-1198.

31. Beall, R., Herdklotz, J. and Sass, R.L. (1970) Molecular Properties of Local Anesthetics: The Crystal Structure of Procaine Hydrochloride. **Biochem. Biophys. Res. Commun**., 39:329-334.

32. Beall, R., Herdklotz, J. and Sass, R.L. (1970) A Refinement of the Crystal Structure of ß-Isoprene Sulfone. **Acta Cryst**., B26:1633-1635.

33. Herdklotz, J. and Sass, R.L. (1970) The Crystal Structure of Acetylcholine Chloride: A New Confirmation for Acetylcholine. **Biochem. Biophys. Res. Commun.**, 40:583-588.

34. Sass, R.L. (1970) Molecular Properties of Local Anesthetics: The Crystal Structure of 2-Diethylaminoethyl p-Methoxybenzoate Hydrochloride. **Biochem. Biophys. Res. Commun**. 40:833-838.

35. Sass, R.L. (1970) Exploring the Nerve Cell. **The Rice Review**, Vol. 5, No. 1.pp. 16-21.

36. Sass, R.L. (1971) Profile of the Rice Experience. **The Rice Review**, Vol. 6, No.1.

37. Gansow, O.A., Beckenbaugh, W.M. and Sass, R.L. (1972) Carbon-13 Nuclear Magnetic Resonance of Pharmaceutical Agents: Benzocaine Hydrochloride Anesthetics. **Tetrahedron**, 28:2691-2696.

38. Kahler, G.A., Fisher, F.M. and Sass, R.L. (1972) The Structure of the Hinge Ligament of Spisula Solidissima. **Tex. Soc. Elect. Micro**., 4:4-8.

39. Herdklotz, J., Werness, P. and Sass, R.L. (1973) The Crystal Structure of 2 Diethylaminoethyl p-Nitrobenzoate Hydrochloride. **J. Cryst. Mol. Struct**., 3:271-275.

40. Billups, W. E., Chow, W. Y., Leavell, K. H., Lewis, E.S., Margrave, J. L., Sass, R. L., Shieh, J. J., Werness, P. G., Wood, J. L. (1973) Structure and Thermochemistry of Benzocyclopropenes. The Question of Bond Fixation and Strain Energy. **J. Am Chem. Soc.**, 95:7878-7880.

41. Sass, R.L. and Werness, P. G.(1973) Acetylcarnitine: on the Relationship Between Structure and Function. **Biochem. Biophys. Res. Commun**., 55:736-742.

42. Mahajan, V. and Sass, R.L. (1974) The Crystal Structure of Acetylcholine Perchlorate. **J. Cryst. Mol. Struct**., 4:15-21.

43. Sass, R.L. and Nichols, T.D. (1974) Crystal Structure of Tetramethylammonium 1,1,2,4,5,5-hexacyanopentadienide. **Zeit. Cristall**., 140:1-9.

44. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1974) Optical Diffraction Analysis of the Cardiac Z Band. **Fed. Proc**., 33:1333.

45. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1974) Unit Cell Z Lattice in Cardiac and Skeletal Muscle. **J. Cell Biol.**, 63:114a.

46. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1975) Z Lattice in Mammalian Skeletal Muscle Having Different Z Band Widths at Rest Length. **J. Cell Biol.**, 67:137a.

47. Shieh, J.J. and Sass, R.L. (1975) The Molecular Structure of Palmitylcarnitine Chloride. **Biochem. Biophys. Res. Commun**., 64:304-310.

48. Phillips, G.N., Quiocho, F. Sass, R.L., Werness, P, Emery, H. Knapp, F. and Schroepfer, G. J. Jr. (1976) Sterol Biosynthesis: Establishment of the Structure of 3-Bromobenzoylyoxy-5-Cholest-8-en-15-ol. **Bioorganic Chem**., 5:1-9.

49. Marsh, M.E., Hopkins, G., Fisher, F.M. and Sass, R.L. (1976) Structure of the Molluscan Bivalve Hinge Ligament, A Unique Calcified Tissue. **J. Ultrastruct. Res**., 54:445-450.

50. Kahler, G.A., Sass, R.L. and Fisher, F.M. (1976) The Fine Structure and Crystallography of the Hinge Ligament of Spisula Solidissima. **J. Com. Physiol.**, 109:209-220.

51. Kahler, G.A., Fisher, F.M. and Sss, R.L. (1976) The Chemical Composition and Mechanical Properties of the Hinge Ligament in Bivalve Molluscs. **Bio. Bull**., 151:161-181.

52. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1977) Optical Diffraction of the Z Lattice in Canine Cardiac Muscle. **J. Cell Biol**., 75:818-836.

53. Marsh, M., Hamilton, G. and Sass, R.L. (1978) The Crystal Sheaths from Bivalve Hinge Ligaments. **Calc. Tiss. Res**., 26:45-51.

54. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1979) The Z Lattice in Canine Cardiac Muscle. **J. Cell Biol**., 83:187-204.

55. Marsh, M.E. and Sass, R.L. (1980) The Molluscan Bivalve Hinge Ligament: A Review. **Tex. Soc. E.M. Journal**, 11:9-14.

56. Marsh, M.E. and Sass, R.L. (1980) Aragonite Twinning in the Molluscan Bivalve Hinge Ligament. **Science**, 208:1262-1263.

57. Goldsteinm, M.A., Stromer, M.H., Schroeter, J.P. and Sass, R.L. (1980) Optical Reconstruction of Nemaline Rods. **Experimental Neurology**, 70:83-97.

58. Goldstein, M.A., Stromer, M.H., Schroeter, J.P. and Sass, R.L. (1980) Optical Diffraction and Reconstruction of Z Bands in Skeletal Muscle. **J. Cell Biol**., 87:261a.

59. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1981) The Z band lattice in a slow skeletal muscle. **Tex. Soc. E.M. Journal**, 12:19.

60. Marsh, M.E., Summerall, R.D. and Sass, R.L. (1981) Lysosomes and the Modulation of Cell Morphology in the Isthmas Region of the Outer Mantle Epithelium of the Extuarine Clam, Rangia cuneata. **J. Ulstruct. Res**., 77:146-159.

61. Marsh, M.E. and Sass, R.L. (1981) Matrix Mineral Relationships in the Scallop Hinge Ligament. **J. Ulstruct. Res**., 76:57-70.

62. Goldstein, M.A., Schroeter, J.P. and Sass, R.L. (1982) The Z Band Lattice in a Slow Skeletal Muscle. **J. Muscle Res. and Cell Motility**, 3:333-348.

63. Marsh, M.E. and Sass, R.L. (1982) Phosphoproteins in the extrapallial fluid and shell of clams. **J. Cell Biol**., 95:125a.

64. Goldstein, M.A., Schroeter, J.P., and Sass, R.L. (1983) Widened Z bands in cardiac hypertrophy. **J. Mol. Cell. Cardiol. Suppl**. (Symposium at Jouy-en Josas, France).

65. Zimmer, D.B., Goldstein, M.A., Schroeter, J.P., and Sass, R.L. (1983) Additional evidence for a simple multi-subunit Z band in striated muscle from localization of alpha-actinin. **J. Cell Biol**., 97:51a.

66. Goldstein, M.A., Zimmer, D.B., Schroeter, J.P. and Sass, R.L. (1983) Additional evidence for a Z band model derived from cardiac muscle. **J. Mol. Cell Cardiol**. Vol. 15 Supplement.

67. Marsh, M.E. and Sass, R.L. (1983) Calcium-binding phosphoprotein particles in the extrapallial fluid and innermost shell lamella of clams. **J. Exp. Zool**., 226:193-203.

68. Marsh, M.E. and Sass, R.L. (1983) Distinct calcium pools within a calcium- binding phosphoprotein. **Fed. Proc**., 42:1924.

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Exhibit D

FORMER EXPERT TESTIMONY

Docket No. 52-042; NRC-2010-0165; *Exelon Nuclear Texas Holdings, LLC, Early Site Permit Application for the Victoria County Station Site, Notice of Hearing, Opportunity To Petition for Leave To Intervene, and Associated Order Imposing Procedures for Access to Sensitive Unclassified Non- Safeguards Information and Safeguards Information for Contention Preparation*, 75 Fed. Reg. 71467 (January, 2011).

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Civil Action No. 1:07-cv-00985-LY; *Coastal Habitat Alliance v. Jerry Patterson, et al.*; In the U.S. District Court, Western District of Texas, Austin Division (July, 2008).