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Edited by

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DR. DON MERRILL REES MEMORIAL AWARD

This award was created in 1987 by the Utah Mosquito Abatement Association to acknowledge exceptional contributions to mosquito control in Utah. The award honors Dr. Don Merrill Rees, 1901-1976, who was often referred to as the 'Father of Mosquito Abatement in Utah.'

The 1996 recipient of the sixth Dr. Don Merrill Rees Memorial Award is Ted Davis. Ted, a Native of Idaho, first came to Utah in 1949 to enter the University of Utah following graduation from high school in Carey, Idaho. He received his B.S. in Zoology in 1953 and went directly to the Army. In the Army he served for almost two years in Taegu, Korea. While not his main duty, Ted worked on some mosquito projects.

Upon returning to the U.S. from Korea in 1956, Ted began a program of study to earn a Masters degree, under the direction of Dr. Don Merrill Rees, at the University of Utah. In 1957, Ted received his M.S. degree after completing a thesis entitled, 'The Mosquitoes of Carey and Vicinity, Blaine County, Idaho.' During his studies he established two records for mosquito species not previously found in Idaho, *Aedes schizopinax* and *Culiseta alaskensis*. Ted spent the next three years at the University taking classes and working summers with Archie Hess and the CDC field station in Logan, UT (1957), Greeley, CO (1958) and field studies in Grand Junction, CO (1959).

In 1960, Ted became an entomologist with the Utah County Health Department. His work at the health department led to the establishment of the Utah County Mosquito Abatement Program, which he directed from 1963-1965. The summer of 1965, Ted spent working for the Salt Lake City Mosquito Abatement District.

Ted left Utah in December of 1965 for a job with the Colorado Health Department as a medical entomologist. Ted retired from that position this past spring after more than 30 years of service. A few highlights during those years included: a bubonic plague epizootic in tree squirrels in north-east Denver (1968), a massive plague epizootic throughout Colorado (1976), coordination of vector control activities following the Big Thomson Flood (1976), SLE outbreak (1985), WEE and SLE outbreak in eastern Colorado (1987), and coordinating field research activities on Sin Nombre virus (hantavirus) (1993-1996).

Ted has been an active member in the American Mosquito Control Association, Society for Vector Ecology, West Central Mosquito and Vector Control Association (serving as secretary from 1974 to 1976), and the UMAA. He has attended many of the UMAA Annual Meetings over the years. To our friend and colleague, the UMAA and its members are honored to present **Ted Davis** with its highest award, the **Dr. Don Merrill Rees Memorial Award.**

History of Water Development in the State of Utah

DAVID G. OVARD

General Manager
Salt Lake County Water Conservancy District
Salt Lake City, Utah

All that happens in Utah is defined in terms of the availability of water. The history of water development in the state is a never ending saga of how to meet ever-changing and increasing needs with the same amount of water.

The Utah State Water Plan prepared by the Division of Water Resources states that there is about 8.5 million acre-feet of water produced annually from the water sheds of the state. This includes surface water flows as well as recharge to the groundwater reservoirs. One acre-foot (AF) is the amount of water required to cover one acre of land to a depth of one foot. One million AF is the amount of water in Utah Lake or Strawberry Reservoir when they are full. About 244,000 AF are currently used for municipal and industrial purposes; 2.3 million AF are used by agriculture; 1.7 million AF by wetlands, and over 4 million AF are lost to evaporation, with 3 million AF attributable to the Great Salt Lake alone. Half of the water produced each year in Utah is lost to evaporation. Of the currently developed water in the state, something in the range of 80% to 90% is used for agriculture.

Some significant events in Utah water development history are as follows: In presenting information, I am drawing liberally from:

1. A Historical Overview of the Evolution of Institutions Dealing With Water Resource Use and Water Resource Development in Utah - 1847 through 1947, A Masters of Science Thesis, Utah State University, 1989, by John Swenson Harvey.

2. The Weber River Basin: Grass Roots Democracy and Water Development, Utah State University Press, 1994, by Richard W. Sadler and Richard C. Roberts. From 1847 to 1877 water was developed on a cooperative basis under ecclesiastic oversight and territorial county courts. In 1869 the coming of the railroad moved the focus from survival to economic development and speculation. From 1866 to 1902 the passage of various federal acts culminating with the Reclamation Act of 1902 greatly influenced water policy in Utah and the West. The General Mining Law of 1866 gave sanction to the doctrine of prior appropriation.

A territorial law in 1880 allowed for private ownership of water which could be traded as private property. It also provided for the incorporation of mutual irrigation companies.

A number of private, profit-oriented water companies were tried during this period and none were successful. High initial investments and a long period of capital recovery proved to be obstacles too great to overcome. Neither the mutual irritation companies nor the for-profit promotions did much to rationalize the administration of

Utah's water resources. The former perpetuated pioneer fragmentation while the latter introduced a welter of contending claims and false undertakings.

In 1888, Salt Lake City entered into its first Utah Lake exchange agreement to deal with a rapid increase in the population of the city.

In 1896, the legislature established the Utah State Board of Land Commissioners to promote the settlement of land in Utah, manage the monies derived from the sale of public lands, select potential reservoir sites around the state, and report on their possibilities to the governor and legislature. The office of State Engineer was created in 1897 and its responsibilities defined. The State Engineer was directed to survey and propose plans for state reservoirs. A statute in 1903 returned control of water to the public and placed the supervision of water rights under the State Engineer.

In 1902 it was reported that the unprecedented drought caused the water flow in the Jordan River to decrease sharply and eventually stop altogether.

From 1906-1921 irrigation and drainage districts were authorized under various state laws to provide a mechanism for joint action on the part of farmers and other water users and to convey the power to bond, levy taxes, and condemn property. The state experimented with state-sponsored water development through direct projects of the Board of Land Commissioners and through lending programs which funded the private initiatives of individual farmers and various mutual irrigation companies, districts, and corporate entities. The state met both failure and success in these activities.

A Utah Water Conservation Commission was established and existed from 1909 to 1917 to help integrate the activities of the state's water management officials with the federal programs and private efforts underway. A very important project undertaken during this period was the Strawberry Project designed by both state and federal officials, but funding came from the federal government. The reclamation Service played the dominate role in construction. The Strawberry Valley Water Users Association was organized to repay the costs of the project.

The Utah Water Storage Commission was created to investigate the full and proper development and utilization of the state's water and existed from 1921 to 1941. It was given the responsibility of working with the federal government and other states to promote a Colorado River Project. The Colorado River Compact was finalized in 1922. The Commission approved and coordinated all Utah projects undertaken by the federal government through the Bureau of Reclamation (BOR). Some of the prominent projects built by the BOR during this period were Hyrum, Ogden River, Moon Lake, Sanpete, Provo River, and Current Creek. Many of the projects of this era were a direct response to the great drought of the early 1930's

In a report to the Governor for the years 1931 and 1932, the State Engineer declared that "it was a matter of common knowledge that practically all the state had been appropriated." In 1935, the legislature required groundwater users to file water applications with the State Engineer. This was forced by the drilling of many emergency wells at the tail end of a period of great drought.

The Metropolitan Water Act of 1935 was passed to allow cities to participate in projects. Following a period of drought, the cycle changed and the state had to deal with flooding. In 1937 the legislature created the Utah State Soil Conservation Committee.

In 1941, the Publicity and Industrial Development Board assumed the duties of the Utah Water Storage Commission. However, the legislature saw the value of having a separate agency involved with water development and created the Utah Water Power Board in 1947.

In 1941, the legislature passed the Water Conservancy Act to help water users finance complex water development projects and to obtain payment from both direct and indirect beneficiaries. The Conservancy Act was patterned after the federal model of repayment organizations utilized on BOR projects and provided a mechanism for funding larger projects.

Major projects sponsored by water conservancy districts are the Weber Basin Project and Central Utah Project. These projects were planned, financed and constructed by the federal government in a cooperative effort with local entities who participated in the planning process and guaranteed repayment of the project costs.

In 1967, the Utah Water and Power Board was replaced by the State Division of Water Resources, which was given the charge to develop a State Water Plan.

In 1993, the federal government announced that it was effectively finished as a developer of water in Utah and the West. This marks the end of an era.

Projects and Dams Constructed in Utah by the Bureau of Reclamation.

Central Utah Project - Bonneville Unit
Bottle Hollow Dam
Current Creek Dam
Jordanelle Dam
Soldier Creek Dam
Starvation Dam
Upper Stillwater Dam

Central Utah Project - Jensen Unit
Red Fleet Dam

Central Utah Project - Vernal Unit
Steinaker Dam

Emery County Project
Huntington North Dam
Joes Valley Dam

Flaming Gorge Project
Flaming Gorge Dam

Glen Canyon Project
Glen Canyon Dam in Arizona
(Lake Powell largely in Utah)

Hyrum Project
Hyrum Dam

Moon Lake Project
Midview Dam
Moon Lake Dam

Newton Project
Newton Dam

Ogden River Project
Pineview Dam

Provo River Project
Deer Creek Dam

Sanpete County Project
Horseshoe and Ephraim Tunnels
(transbasin diversions)

Scofield Project
Scofield Dam

Strawberry Valley Project

Strawberry Tunnel
(transbasin diversion)
(The old Strawberry Dam was replaced by Soldier Creek Dam)

<u>Weber Basin Project</u>
A.V. Watkins Dam
Causey Dam
East Canyon Dam
Lost Creek Dam
Wanship Dam
Pineview Dam Enlargement

<u>Weber River Project</u>
Echo Dam

Many of the smaller water projects of the state have been financed by various state agencies over the past 100 years, as I have pointed out in my historical review. With the federal government out of the picture in water development, the focus has shifted to the State. The question before the Governor and other state officials is what role will the state play in future water development.

The state's water resources are finite and there are many competing interests. How much more growth can Utah sustain? Over 80% of the developed water resources are utilized by the agricultural sector. Can this continue? How important are the wetlands? How much water should be allocated for environmental needs and values?

There is no clear statewide perspective as to what is needed or what should be done. On one hand, the state and many counties and local communities are promoting economic development and the creation of new jobs, all of which are dependent on new water development. On the other hand, the state and all others concerned are struggling with how to preserve our environmental assets and values and our traditional way of life. To a large degree, we are all struggling with the determination of what we really want and in what direction we need to go. I don't have a lot of answers for you at this time.

The Salt Lake County Water Conservancy District has been working closely with the state to determine our needs and to assess alternatives to meet them. State projections say that the Salt Lake Valley will double in population over the next 30 to 40 years. We will need twice as much water as we are now using.

What is implied in these statistics is that we need to add a lot more facilities. We need to duplicate or add another water system to the valley, which will include sources of supply, reservoirs, pipes, booster stations and all other appurtenant equipment and facilities over this period. To this end we are looking at importing at least 50,000 AF of water from the Bear River into the Salt Lake County, through a state-sponsored project which will include dams, large-diameter pipes and expensive treatment facilities. We are looking at converting at least 50,000 AF of Utah Lake water, that is now used for agricultural purposes, to municipal uses through high-tech membrane filtration processes. We know that somewhere in the future we will have to rely more on conservation. Still, all of this may not be enough. The estimated cost of these projects and related facilities is easily $2 to $3 billion. At the same time we are adding new facilities, the existing system is crumbling and decaying. There are major facilities in many areas of Salt Lake County that are 50 to 100 years old.

It is not an easy thing to say, but we will probably need $5 to $6 billion for municipal water needs to Salt Lake County over the next 30 to 40 years. Please keep in mind that I have not addressed treatment of wastewater, roads or any other infrastructure needs which also will require large expenditures in the coming years. I believe that there are similar needs in many other parts of the state.

What this means, whatever our role is in Salt Lake County or throughout the State of Utah, is that there will be no shortage of challenges for any of us. We are all going to be pushed to find new and creative ways to address problems. We are all going to be questioned if there is a better or cheaper way of doing things.

We are all going to be required to be more professional, to communicate better, to be more efficient, and to incorporate more technology and science into everything that we are doing. We will also be required to manage better and to be more open-minded and smarter in how we deal with our employees, our customers, and the public in general.

All this can be a bit bewildering and intimidating. Most of us are uncomfortable in addressing the roles into which we feel ourselves being drawn. My advice to you is the same as I offer to myself.

1. We need to plan for the future. We need to project our needs, identify our future requirements and anticipate challenges. Knowing where we are at present and where we need to be in the future is a keystone to success.

2. We need to hire good people. There is no greater resource than well-trained and well-prepared workers with good attitudes and outlooks and we need to be prepared to compensate them fairly and to treat them with respect and dignity.

3. We must never be content with mediocrity. We must expect the best from ourselves and our employees and we must work with them to meet our expectations.

Survey and Testing for African Honey Bee in Utah

EDWARD BIANCO

State Entomologist
Utah Department of Agriculture
Salt Lake City, Utah

The African Honey Bee (AHB) has migrated steadily northward since its accidental release in Brazil in 1956. As it has expanded its range, AHB has become a serious threat to the beekeeping industry because of its aggressive behavior. It has also become a very serious health threat to people and animals due to its propensity to sting more readily and in greater numbers than our domestic honey bee.

The Utah Department of Agriculture approach to the AHB concern will be one of survey and detection with testing. Based on what has happened in Mexico and Texas, it appears that the natural migration of AHB cannot be stopped. It was reported in Mexico during the mid to late 80"s and in Texas in 1990. African Honey Bee was also discovered in New Mexico and Southern Arizona in 1993 and has been moving northward.

Because of this continued movement a survey and detection program for AHB, in cooperation with USDA-APHIS, was planned and put into action for the southern border areas of Utah during the summer of 1994.

Surveying is being done using a USDA designed bee trap. The trap consists of a corrugated cardboard box 20 inches long, 12 inches wide and 9 inches deep containing a bee lure developed by Dr. Orley Taylor at Kansas State University. The trapping area continues from the Four Corners area in the east, west along the southern Utah border, around Lake Powell and over to Nevada.

We feel that early detection, supported with information and education, will be a major defense mechanism against this alarming insect.

Testing for African Honey Bee in Utah will be done using the FABIS method developed by USDA (Thomas Rinder and H. Allen Sylvester). FABIS is a rather quick method to determine AHB. The procedure is to measure the fore-wing length and then determine the probability of being African. If PA is less than .90 the sample is European. If PA is .99 then the sample is African.

Other means used to determine AHB are:

A. Length of 10 cells in a comb (A preliminary field test)
   1. EHB 5.2 cm + (1.99")
   2. AHB 4.9 cm (1.93")

B. Morphometrics
   1. Measure wing cells
   2. Pollen mirror
   3. Leg parts

   Morphometrics is .95 accurate.

Floodplains and Razorback Sucker in the Middle Green River

TIMOTHY MODDE

Colorado River Fish Project
U.S. Fish and Wildlife Service
Vernal, Utah

INTRODUCTION

Fishes native to the major tributaries in the Colorado River drainage evolved in a highly variable environment. Spring run-off often resulted in sediment rich, torrential flows that receded to low base flows during late summer, fall, and winter. The difference between maximum and minimum flows in the same year was often a ratio between 25 to 45:1 in main tributaries. Following the construction of main stem reservoirs, the variation in the natural hydrograph was moderated by reducing the magnitude of spring peaks and increasing the magnitude of base flows. These changes reduced the active floodplain and partitioned the main stem tributaries between dams and the cold water tailwaters produced from their hypolimnetic reservoir releases. the direct impacts of dam construction to native fish were to restrict migratory movement, reduce access to inundated floodplains, modify temperature regimes, and reduced sediment load.

Among the four endangered species found in major tributaries of the Colorado River, humpback chub *Gila cypha,* bonytail *G. elegans,* Colorado squawfish *Ptychocheilus lucius,* and razorback sucker *Xyrauchen texanus,* floodplain habitats are known to be important to all life stages of only the latter. Adults use floodplain habitats following spawning (Tyus and Karp 1990) and age-0 fishes use wetlands connected with the river in the spring as nursery sites through the summer (Modde 1996). Recovery of razorback sucker will be dependent on some level of floodplain/riverine wetland restoration.

DISTRIBUTION AND BIOLOGY OF RAZORBACK SUCKER

The razorback sucker is a long-lived fish, living up to 40 to 50 years old. Today, the largest populations of this monotypic species exist in Lake Mohave, Arizona, and the middle Green River, Utah (Minckley et al. 1991). The Lake Mohave population, approximately 20,000 fish (Marsh 1995), consists of a declining, senescent group of individuals spawned during or prior to the filling of the reservoir (Minckley et al. 1991). The largest riverine population of razorback sucker exists in the middle Green River, approximately 500 fish, and also consists mostly of older fish, although some recruitment is occurring (Modde et al. 1996). Fewer numbers of razorback sucker have been collected in the upper Colorado and Gunnison rivers near the Grand Valley, Colorado, in the lower Green River, Utah, and in the San Juan River in both Utah and New Mexico (Modde et al. 1995). The razorback sucker was listed by the U.S. Fish and Wildlife Service as an endangered species in 1991. The direct cause of decline in all razorback sucker populations has been lack of recruitment (Minckley et al. 1991).

The extant populations of razorback

sucker in the upper Colorado River basin are associated with low gradient sections of river. The largest population of razorback sucker in the subbasin, the middle Green River, occurs in the area with the greatest available floodplain acreage (Irving and Burdick 1995). Although much is unconfirmed about the life history of razorback sucker, the chronology of the natural hydrograph and connection of off-channel habitats has been associated with spawning and recruitment of this species. Razorback sucker migrate to spawning areas above low gradient reaches of the Green River and spawn on the ascending limb or peak of the hydrograph (Figure 1) (Tyus 1987). The largest known spawning aggregation occurs approximately ten miles below Split Mountain Canyon (river mile 311), just upstream of the low gradient despositional reaches of the middle Green River. After spawning, razorback sucker larvae emerge from spawning areas and drift downstream. Larvae have been collected in the Green River between Jensen and Ouray, between the confluence of the San Rafael River and Labyrinth Canyon, and in the Colorado River in Canyonlands National Park (Robert Muth, Larval Fish Laboratory, Colorado State University; personal communication). The chronology of spawning permits the emergence of larvae during peak flows, the period of maximum floodplain inundation.

Tyus and Karp (1990) suggested that the timing of spawning may be linked with the availability of riverine wetlands for both adult and age-0 razorback sucker. Post-spawned adults could feed on abundant invertebrate prey and age-0 fish benefited from high densities of zooplankton, warm temperatures and cover from aquatic macrophyte growth. In an effort to demonstrate use of wetlands by razorback sucker, the outlet water control structure of an 80 hectare wetland (Old Charley Wash) on the Ouray National Wildlife Refuge was modified in 1995 to capture fish upon draining and allow a census of fish present in the wetland. Although no more than four juvenile razorback sucker have been documented in the upper Colorado River Basin since 1965, 28 and 45 juvenile razorback suckers were collected from Old Charley Wash in fall 1995 and late summer 1996 (Modde 1996, USFWS unpublished data), respectively. In addition, adults were also collected in the wetland following spawning during both years of the study.

HYDROLOGY AND MANAGEMENT STRATEGIES

Recovery of razorback sucker is dependent on the combination of some frequency of out-of-bank flow and wetland restoration to insure both successful spawning and survival of early life stages of this fish. Historically, the peaks of the Yampa and Green rivers were slightly staggered (Figure 2) which maximized the duration of flood plain inundation. Prior to construction of Flaming Gorge Dam, the Green River below Jensen flowed out of its banks approximately every 1.5 years, whereas, out-of-bank flows occurred only every 3.4 years following construction (Flo Engineering, 1996). The unregulated hydrograph of the Yampa River peaks earlier and higher than that of the Green River. The flows of the Green River peak later and has a slightly higher base flow. Historically, the high glows from the Yampa River probably provided the environmental cues to initiate razorback sucker spawning and also caused initial over-bank flooding, while flows from the Green River above the confluence of the Yampa River peaked afterward and functioned to maintain flood plain inundation following the decline of peak flows from the Yampa River. Thus, the combination of magnitude and duration interact to improve spawning success and created nursery habitat. Because the historical flow magnitudes and duration are now reduced in frequency due to Flaming Gorge Dam, efforts to increase the frequency of flood plain inundation can be increased at selected sites through levee removal and timely increases in reservoir discharge.

Although it has been demonstrated that age-0 razorback sucker grow and survive in wetlands, it is also evident that the majority of young fish produced in inundated wetlands are non-native fishes that may further aggravate recovery of either razorback sucker or other endangered fishes in the Upper Colorado River Basin. Research efforts are currently underway to describe the type of wetland restoration that is optimal for the recovery of razorback sucker and other native fishes in the middle Green River system. Possibilities being considered include levee removal to prevent wetland impoundment following decline of river elevation in the spring, and non-native fish removal. Some evidence suggests that high flows can reduce the numbers of some non-native fishes (Muth and Nesler 1993). The combination of wetland restoration and flow recommendations represent the most viable mechanisms for recovering the razorback sucker in the upper Colorado River Basin.

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Figure 1. Instantaneous flow peaks from the Yampa (Deerlodge) and Green (Freendale) rivers during the period of record from 1947 to 1992.

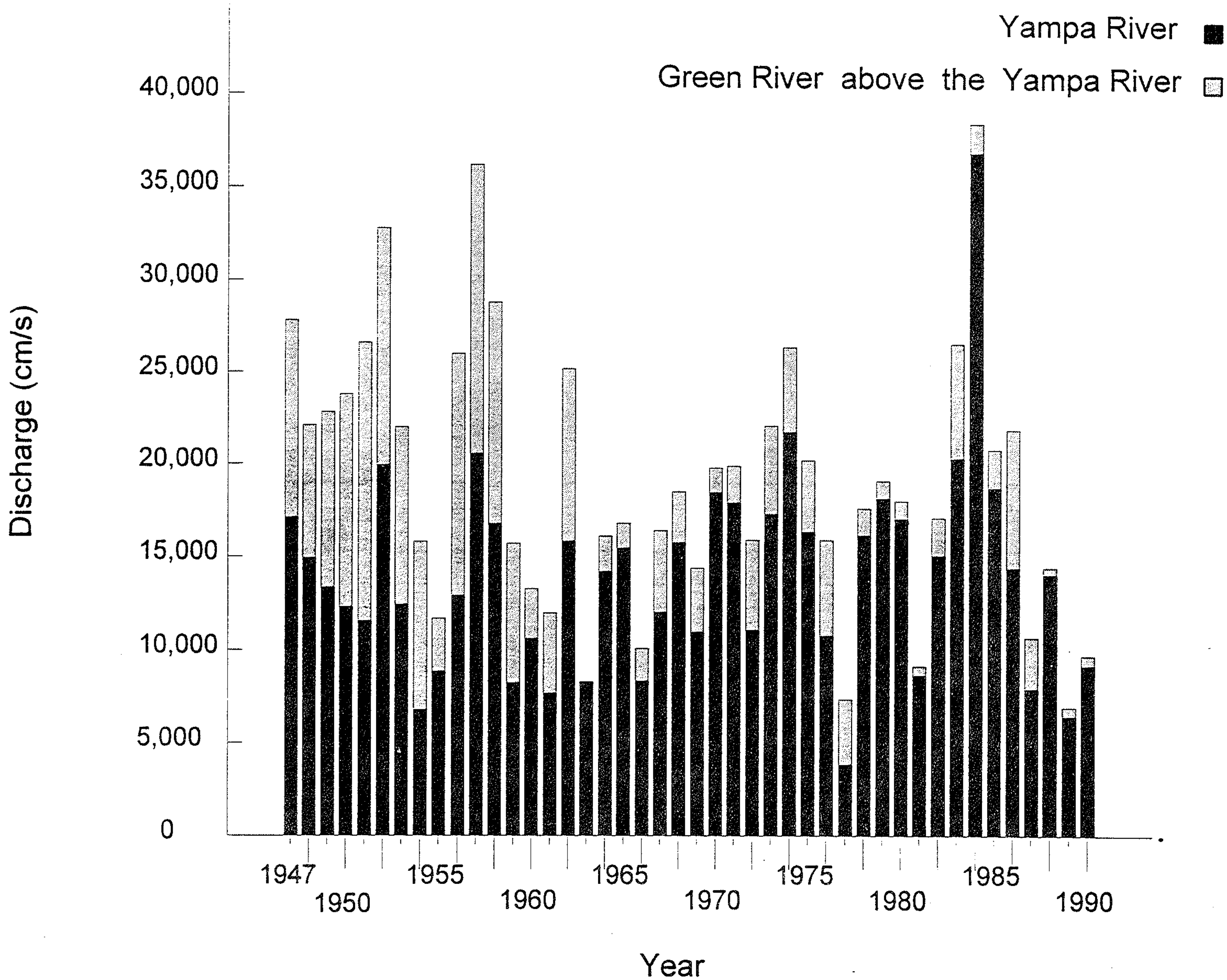
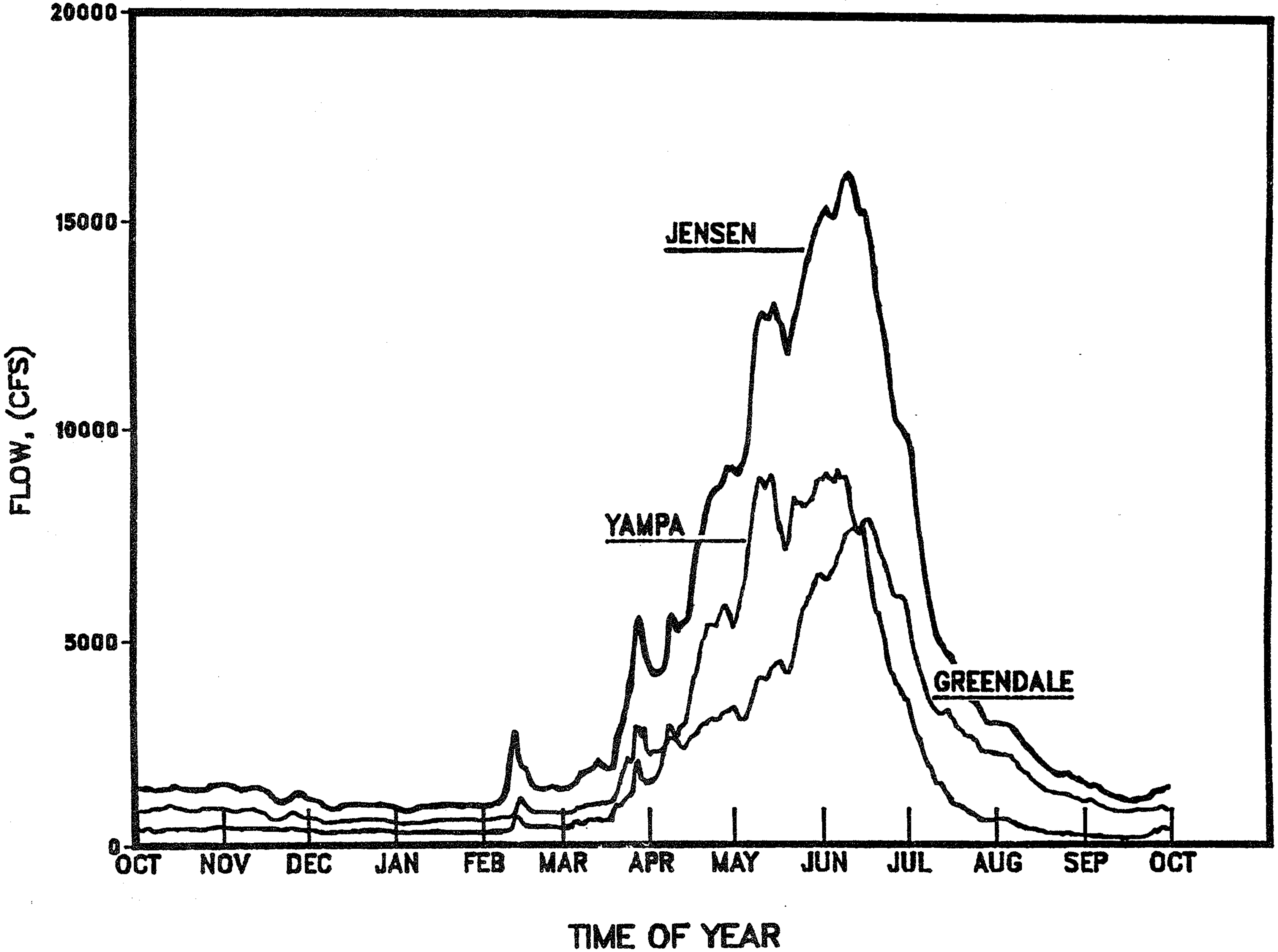


Figure 2. Historic hydrographs showing the magnitude and duration of flow in the Yampa and Green Rivers prior to the construction (1951 - 1962) of Flaming Gorge Dam. The Green River at Jensen is below the confluence of the Yampa River and the Green River at Greendale is above the confluence of the Yampa River.



1996 Legislature and Special Districts

Kenneth L. Minson

Utah Association of Special Districts, Chairman
South Salt Lake County MAD
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As an introduction to this paper dealing with where Special Districts are, I thought it might be interesting to give you a brief review of a few of the different kinds of Districts that make up our Utah Association of Special Districts (UASD). I will list just a few of the two categories that exist.

Independent Districts are comprised of: County Improvement for Water, Sewerage, Flood Control, Electric and Gas County Service Areas. There are Drainage, Fire Protection, Irrigation, Metropolitan Water, Mosquito Abatement, Cemetery, Public Transit, various Redevelopment Agencies, Water conservancy, Airport Authority, Hazardous Waste Facilities, and several more. There are Dependent Districts made up of County Improvement, Municipal Improvement, Soil Conservation, Local Mental Health and Substance Abuse Authority.

As usual, special taxing and service districts had a special place in the hearts of the 1996 legislature. As an Association of Special Districts, we felt that the temperament of the Utah State Legislature has been modified through meaningful education of key legislators and the continued awareness of the UASD of pending legislation that would affect Special Districts in any way. Efforts to identify both friends of Special Districts and possible foes, also, has helped in moderating or actually stopping harmful legislation.

Jan Furner, the Executive Director of the UASD, has spent hundreds of hours creating favorable coalitions in both Houses of the legislature that will stand up and be counted when and if we need their help. All of us should be especially grateful for his ability to make friends rather than work by implied threats, etc. as some lobbyists are want to do.

There is still a prevailing level of either ignorance of who we are and what we do, or there exists residual frustrations and concerns about Special Districts in the minds of the legislators. For example, the UASD sent questionnaires to all the potential candidates running for office for 1997. Several phoned in to ask just what comprised a Special district. Just who the heck are you? This lack of knowledge of who we are or similar feelings is national in scope. In the publication, "American City and County", a comment is made that truly reflects the mind set of most individuals outside our circle. It states "Special Districts may be undemocratic because they are not directly controlled either by the public or by the elected officials of the parent government". A following comment says, "Despite rapid growth and an increasingly important role in local service delivery throughout the United States, Special District governments face critics who question their impact on other local governments and whether the proliferation of these districts increases or decreases the size of the public sector." John Harrigan in his book, "Potential Change in the Metropolis", suggests that Special Districts are the dominant service providers in the United States.

Special Districts have been around for a long time. Florida created the Road, Highway, and Ferry Act of 1822. This was a roads district established to create and maintain roads.

I mention these statements to impress upon you as Trustees, that Special Taxing and Service Districts are coming increasingly under the gun. We constantly provide data to legislators to keep them informed and, by invitation, testify before different legislative committees year round and thus provide direct testimony and answer questions as they arise.

This year's Legislature considered over 1,300 bills, with 60-70 bills having potential effects on Special Districts. Without mentioning most of them, one or two come to mind that are still a problem or are under consideration for the next session. H.B. 254, the bill that was created to protect legislative intent of the $90 million tax cut, is still on the books. That should be sunseted this year. We'll see. The committee on taxation has authorized a task force to study and make recommendations concerning changes in the property tax code. The League of Cities and Towns, and the counties plus the Special Districts were asked to testify as to what proposed H.B. 462 would do to our taxing ability.

There is a real ground swell to eliminate property taxes. Feelings on the legislature are reflecting the constituencies pressure and I think we will see the State legislature start to act on various areas and/or ultimately eliminate the whole property tax concept in favor of some other methods in which to raise needed local revenues. An area under serious consideration is the Motor Vehicle Fee-in-Lieu. The interim tax committee seemed to be leaning towards using this area of taxation as a place to start implementing other, more judicious ways to tax the public on their vehicles. A flat fee has been suggested and actually formulated out to show what would take place if the property tax were to be eliminated at his level. I feel that if this starts, we may be in for some serious consequences in many Districts that have bonding commitments and budgeting would be more difficult without the sure knowledge of a revenue source that property taxes provide. I have suggested to our managers that they take a long look at what methods might be available to them in order to be ready just in case!

The State and Local Interim Committee met this summer and one of the items on their agenda was to re-codify the Special Taxing Districts part of the State Code. Again, Jan Furner and myself were invited to present testimony as to our feelings concerning the ways the Committee might proceed. Several members of the committee desired that an individual service district be examined in depth before moving on to another. Jan felt that it would be wiser to examine a certain area of the code pertaining to one concept, i.e. the method of selecting board members for the various districts, and compiling this data into one area of the Code for easier access. After some discussion, the Co-chair of the Committee made the motion that the legislative counsel proceed in this manner. It was passed and we scored yet another victory for Special Districts. We felt as an executive committee of the UASD that singling out one set of districts was not in the best interest of all of us. When the Code is opened, changes can be made that are not in the best interests of a district. An example in our work would be the law that allows Mosquito Abatements to enter private property without prior approval. This is absolutely critical to the continued success of mosquito control in Utah.

We appreciate your willingness to allow us to serve you and your continued support in approaching your respective legislators is greatly needed.

Significance of Larval Classification of Fleas (Siphonaptera) as Related to the Adults (An update)

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Salt Lake City, UT

An earlier version of this paper was presented at a previous meeting (Elbel 1988). Flea larval classification is from Elbel (1991) and larval characters are defined in figures 36.14 and 36.18. This paper emphasizes differences in larval and adult classification.

In Pulicidae, Tunginae larvae have short setae on the first 12 body segments (Fig. 36.6). *Echidnophaga gallinacea* is included here but the adult is a Pulicinae.

Larval Pulicinae are divided into 2 groups, both with a single row of setae in the anal comb (Figs. 36.9, 36.11). In the first group, containing *Pulex*, the posterior row on abdominal segment 9 has 8 setae (Fig. 36.8) and there are 5 ventrolateral setae (Fig. 36.9) The second group which includes 3 adult tribes for dog and cat, rabbit and rat fleas has 7 setae on the posterior row of abdominal segment 9 (Fig. 36.10) and there are 3 ventrolateral setae (Fig. 36.11).

In Ctenophthalmini, the anal comb has a single row of setae as in Pulicinae (Fig. 36.11) but the posterior row on abdominal segment 9 has 6 setae (Fig. 36.21) rather than 7 setae as in Pulicinae (Fig. 36.10). Larvae represent a distinct group but adults are Hystrichopsyllidae.

Rhopalopsyllidae have 4 ventrolateral setae, the first extremely long (Fig. 36.12) and the posterior row on abdominal segment 9 has 7 setae (Fig. 36.19).

Hystrichopsyllinae and Stenoponiinae represent one larval group but 2 adult subfamilies of Hystrichopsyllidae. *Sternopsylla distincta* (Elbel & Bossard 1994, 1995) and *Mioctenopsylla* are included here as the posterior row on abdominal segment 9 has 7 setae (Fig. 36.19) rather than 6 setae (Figs. 36.17, 36.21) as in Ischnopsyllidae and Ceratophyllinae to which the adults belong. The anal comb has one seta in the anterior row (Fig. 36.13) for Hystrichopsyllinae-Stenoponiinae but 2 setae in the anterior row (Fig. 36.14) for *S. distincta* and *Mioctenopsylla.*

Rhadinopsyllini larvae represent a distinct group but adults are Hystrichopsyllidae. *Atyphloceras echis* (Kucera 1990) is included here as the posterior row on abdominal segment 9 has 6 setae (Fig. 36.21) rather than 7 setae (Fig. 36.19) as in the Hystrichopsyllinae to which the adult belongs. The mandible is broad, rectangular in *A. echis* but curved to a distal tooth in other Rhadinopsyllini. The anal comb has one seta in the anterior row (Fig. 36.13) which is minute in *A. echis.*

Anomiopsyllini have 2 ventrolateral setae and an anal comb with 2 setae in the anterior row (Fig. 36.15). In the posterior row on abdominal segments 1-5, the second seta is 1/2-3/4 the length of the first and third setae (Fig. 36.16 A). Larvae represent a distinct group but adults are Hystrichopsyllidae.

Phalacropsyllini have the anterior row of short setae on abdominal segments 1-5 with setae 2-5 in a straight line (Fig. 36.20 C) but in all other larvae, seta 3 is in front of the others (Fig. 36.21 D). The anal comb has one seta in the anterior row (Fig. 36.13). Larvae represent a distinct group but adults are Hystrichopsyllidae.

Leptopsyllinae have the posterior row on abdominal segments 1-5 with the second seta 1/4 the length of the first and third setae (Fig. 36.18 B). The anal comb has one seta in the anterior row (Fig. 36.13). *Conorhinopsylla stanfordi* and *Megarthroglossus* are included here but adults are Anomiopsyllini.

In Ischnopsyllidae and Ceratophyllinae, the anal comb has 2 setae in the anterior row (Fig. 36.14) and the posterior row on abdominal segment 9 has 6 setae (Fig. 36.21). However, the posterior row on abdominal segment 8 has 6 setae (Fig. 36.17) in Ischnopsyllidae but 5 setae (Fig. 36.21) in Ceratophyllinae.

Stehr (1991) in his introduction to IMMATURE INSECTS says that there can be only one classification and it must include all life stages so any differences, as in Siphonaptera, chapter 36, must be resolved. Lewis (1992) who reviewed chapter 36 does not believe that flea larval morphology is useful in predicting phylogenetic affinities because larvae of holometabolous insects are free to evolve in their own directions independent of any evolutionary trends shown by the adults. According to Edmunds & Allen (1966), a knowledge of immature stages is essential in establishing the probable phylogeny and classification in Ephemeroptera where aquatic nymphs and aerial adults offer 2 different sets of characters for study. Emden (1957) stated that larval and adult evolution in Holometabola are influenced by different habitats so their characters must have developed in different directions; this enhances the importance of larval characters to insure a means of checking the soundness of an existing classification based on adults. Dyar & Knab (1906) achieved a natural grouping of mosquitoes by correlating larval characters and adult genitalic characters. A natural grouping of fleas may mean some modifications of adult classification to achieve what Edmunds calls, one phylogeny and one classification for both larvae and adults (Elbel 1988).

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(Plate 1)

Siphonaptera. Entire larvae, lateral: 36.6 Pulicidae *Echidnophaga gallinacea* (Westwood). 36.8 Pulicidae *Pulex irritans* Linnaeus. 36.10 Pulicidae *Xenopsylla cheopis* (Rothschild). Terminal anal segments, lateral: 36.7 Pulicidae *Echidnophaga gallinacea* (Westwood). 36.9 Pulicidae *Pulex irritans* Linnaeus. 36.11 Pulicidae *Xenopsylla cheopis* (Rothschild). 36.12 Rhopalopsyllidae *Polygenis gwyni* (C. Fox). 36.13 Leptopsyllidae *Leptopsylla segnis* (Schönherr). 36.14 Ceratophyllidae *Orchopeas leucopus* (Baker). 36.15 Hystrichopsyllidae *Anomiopsyllus hiemalis* Eads & Menzies [Figures 36.6-36.15 reprinted with permission of Kendall/Hunt Publishing Company from Elbel (1991) Siphonaptera, ch. 36, *in* Stehr (ed.) IMMATURE INSECTS v.2, copyright © 1991].

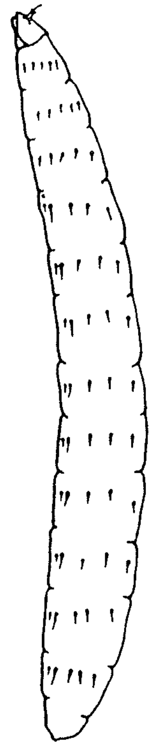


Figure 36.6

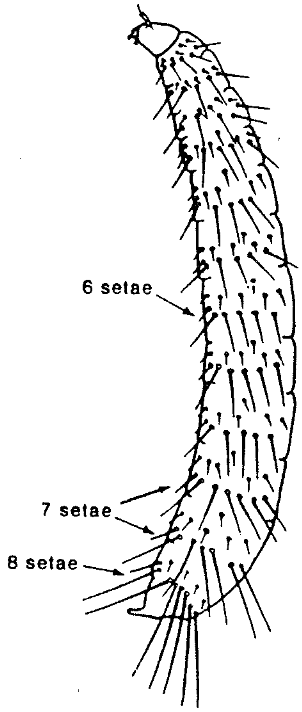


Figure 36.8

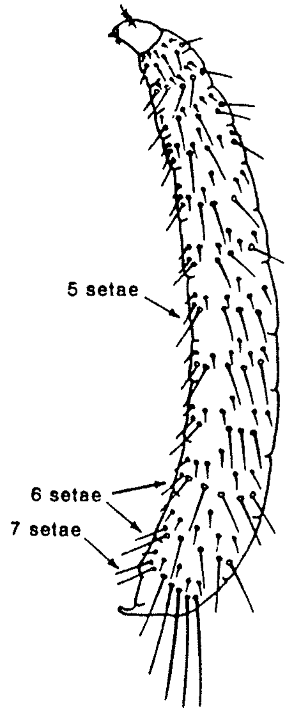
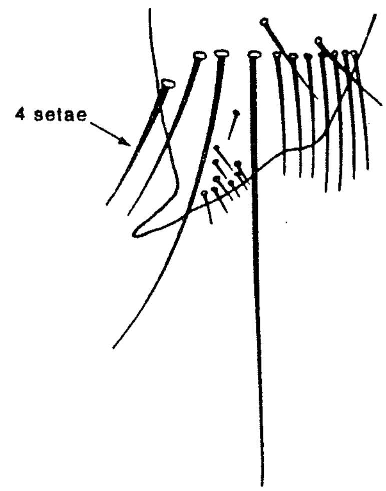


Figure 36.10



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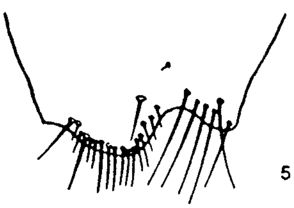


Figure 36.7

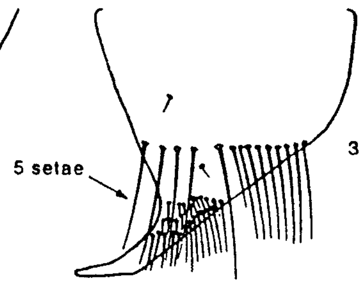


Figure 36.9

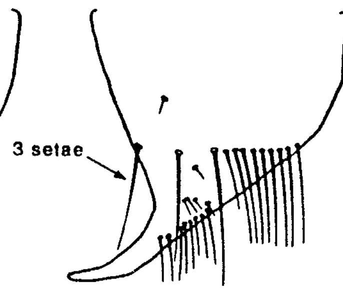
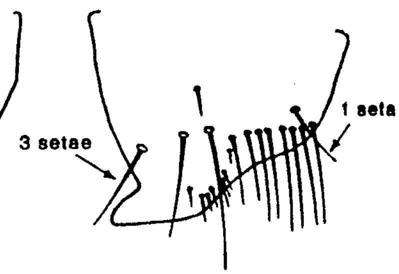


Figure 36.11



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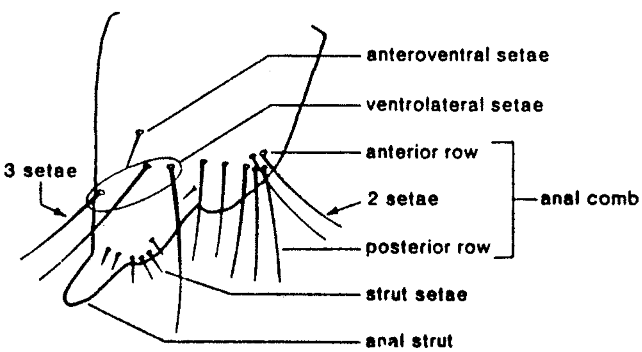

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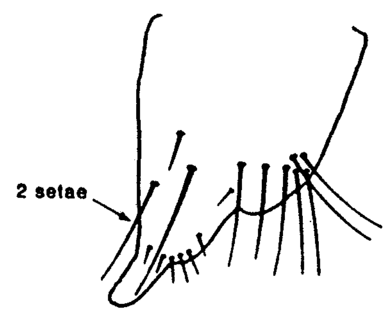


Figure 36.15

Plate 1

(Plate 2)

Siphonaptera. Entire larvae, lateral: 36.16 Hystrichopsyllidae *Anomiopsyllus hiemalis* Eads & Menzies, A, short seta 2 of posterior row. 36.17 Ischnopsyllidae *Myodopsylla insignis* (Rothschild). 36.18 Leptopsyllidae *Leptopsylla segnis* (Schönherr), B, short seta 2 of posterior row. 36.19 Rhopalopsyllidae *Polygenis gwyni* (C. Fox). 36.20 Hystrichopsyllidae *Epitedia wenmanni* (Rothschild), C, short setae 2-5 of anterior row in straight line. 36.21 Ceratophyllidae *Orchopeas sexdentatis* (Baker), D, short setae 3 of anterior row in front of others [Figures 36.16-36.21 reprinted with permission of Kendall/Hunt Publishing Company from Elbel (1991) Siphonaptera, ch. 36, *in* Stehr (ed.) IMMATURE INSECTS v.2, copyright © 1991.

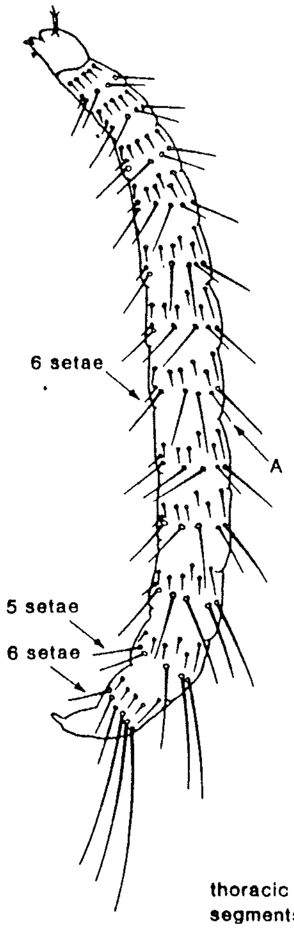
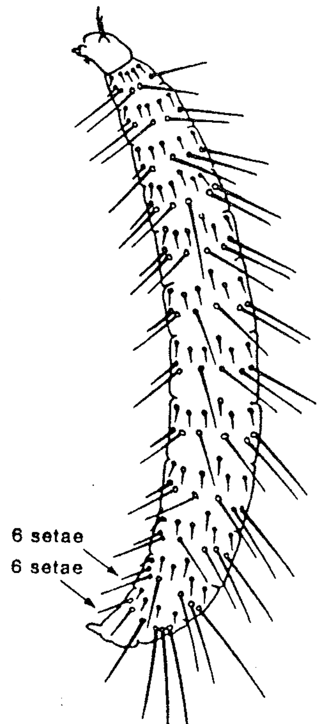


Figure 36.16



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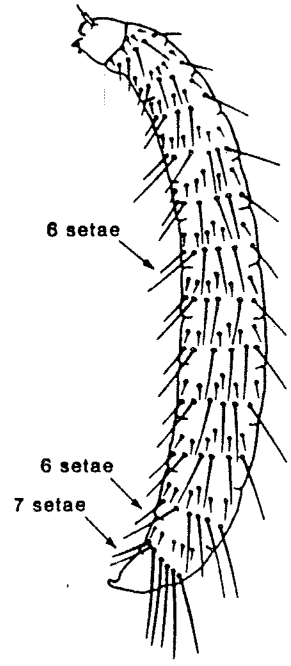

Figure 36.19

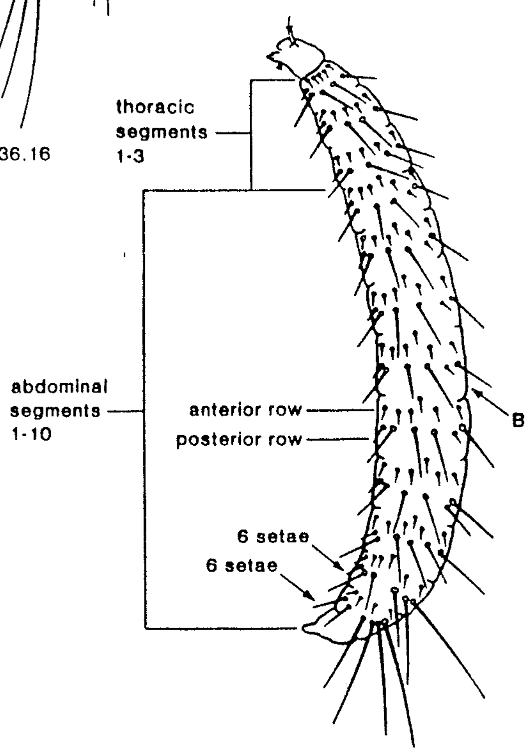

Figure 36.18

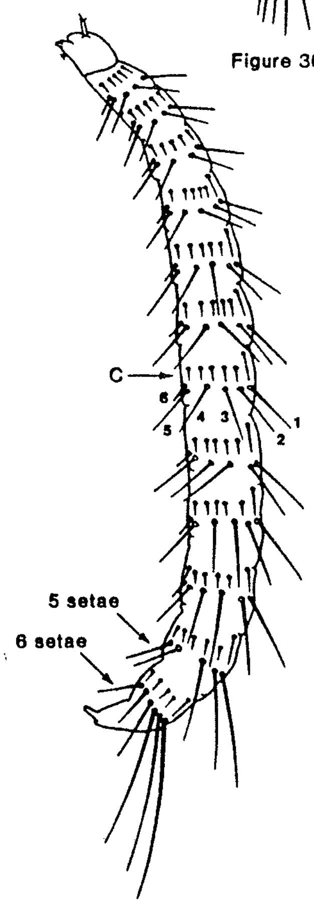

Figure 36.20

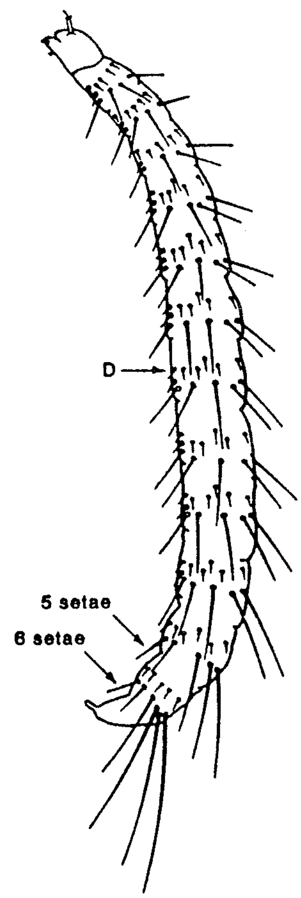

Figure 36.21

Plate 2

Encephalitis Surveillance in Nebraska

WAYNE L. KRAMER and THOMAS E. JANOUSEK

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University of Nebraska
Lincoln, NE

Concerns related to potential increased arbovirus activity in the Midwest following the floods of 1993 prompted the availability of grant funds from CDC/FEMA to Nebraska and 6 other states affected by the floods. This presentation summarizes surveillance data collected by the Nebraska Department of Health/University of Nebraska during the 1994 and 1995 field seasons.

All mosquitoes were collected using CDC miniature light traps supplemented by CO_2 (dry ice). All mosquitoes were transported on dry ice to the laboratory where they were identified, counted and pooled under stereo microscopes on refrigerated cold tables. All mosquitoes were stored in a -70 C freezer before sorting and prior to shipment to the Iowa Hygienic Laboratory where all virus testing was performed. Only *Culex* mosquitoes were pooled and tested for the presence of St. Louis (SLE) and Western Equine encephalitis (WEE) and all pools consisted of 50 or fewer mosquitoes.

A total of 685,582 mosquitoes were collected on 867 trap nights from 9 Nebraska communities from May to October, 1994. A total of 1,359 pools of *Culex* mosquitoes were tested for the presence of SLE and WEE viruses. Two pools, one collected August 22, *1994* from Gering, Nebraska and one collected September 13, 1994 from Scottsbluff, Nebraska, of *Culex tarsalis* mosquitoes were positive for SLE virus. Both collection sites could be characterized as irrigated agricultural land adjacent to residential areas.

Results from 1995 showed a total of 1,163,741 mosquitoes trapped on 848 trap nights in 11 Nebraska communities. A total of 2,788 pools of *Culex* mosquitoes were tested for the presence of SLE and WEE viruses. Thirty isolates were obtained from 1,170 tested pools from Scottsbluff County, Nebraska, 4 isolates were obtained from 463 tested pools from Norfolk, Nebraska and 2 isolates were obtained from 596 tested pools from Grand Island, Nebraska. All 36 strains of WEE virus isolated were from *Culex tarsalis* mosquitoes.

In 1995, the first WEE virus isolates were obtained at 6 different sites in Scottsbluff county on August 16, 1995. On this date, 16 of 399 *Culex* pools tested yielded positive WEE isolates and on September 13, 1995, 4 of 21 pools of *Culex* mosquitoes tested from 4 sites yielded positive WEE isolates.

My Forty Years in Mosquito Control

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In order for me to tell you about the highlights of my forty years in mosquito control it would take the better part of a day. I am sure it would be extremely boring so I will just touch on a few of the funny as well as serious times that I experienced.

I have been honored to serve as President of this Association twice during my forty years in mosquito control. I have had the pleasure of serving as Conference Host on three occasions during this time. The Box Elder District will be the Conference Host for the fall 1997 meetings at the Ogden Park Hotel, September 28,29 & 30, 1997.

My first job in mosquito control was with the South Salt Lake County Mosquito Abatement District in 1956. The late Jay Graham was manager at the time. We used our own vehicles and I worked out of the trunk of my 1940 Chevy. We carried a Bak-Pak 5 gallon sprayer, a short handle metal dipper, vials for collections, a gallon of heptachlor, a bag of BHC dust, a dust dispenser, a 1 gallon metal can to dip up water for the Bak-Pak sprayer, and a pair of boots. It was a real chore to get the job done, but we managed. The office was in the old Midvale Jail. Jay's office was in cell one, bars and all. An interesting place to work out of to say the least.

The first week on the job I was treating a pasture in West Murray and a bull became upset and started to paw the ground. I was very unfamiliar with large animals (I was a city boy), so I ignored the bull. A mistake! The next thing I knew he was charging and I was running with a pair of boots and a 5 gallon spray can on my back through mud and water. I dropped the spray can and literally flew over the fence. The bull then attacked the spray can, crushed it flat and drank the heptachlor. I never did go back to get that sprayer, or what was left of it. I reported the incident to Jay and he just laughed. I believe we have all been threatened or verbally attacked by an upset landowner but I don't think many have been almost trounced by a bull and your equipment smashed. I will never forget that experience. I was really scared.

In 1957 I went to work for the Salt Lake City Mosquito Abatement District and Glen Collett. I started out digging ditches by hand on the drainage crew and then as a spray man and eventually as senior spray man for the district. Glen was good to work for. I recall one time when I came back to base, I believe Gail Brown was with me, I reached in the back of the truck to pick up a dust applicator and as I did Glen came around the side of the truck. I accidentally moved the handle and BHC dust went all over Glen. Glen looked pretty funny. His red hair was all white. On another occasion I sprayed a pasture swale. I believe the property was George Hill's. I used #2 fuel oil since the swale contained pupae. By the next day the swale had turned yellow from the oil. Mr. Hill told Glen if he caught me in there again he would castrate me with a dull knife. The area was a major mosquito source. After that we had to sneak in and treat the area when Mr. Hill left to milk cows. I was a little nervous when we were in the area but it was kind of exciting. I had a lot of practice in running with boots on. There is no way he could have caught me. I believe Larry Jeremy was my partner in crime at the time.

In 1958 Utah had an Encephalitis outbreak. We were right in the middle of it. Most of the crew worked 10-12 hours a day. I worked on the spray crew during the day and went fogging at night. I had a lot of experiences doing that. Too many to mention.

I was shot at (not intentionally) by target shooters west of the Salt Lake Airport. I hit the ground for 5 minutes before the shooting stopped. I was propositioned by a farmers daughter, in fact the whole crew was.

In January 1962 I took over as manager of the Magna Mosquito Abatement District. The Magna District was a real challenge for me with old equipment and very poor records. I spent 11 years there and with the help and support of Evan Lusty, the present manager and the Executive Board, brought the program up to date with the other districts. I believe there were only 4 other districts operating in Utah at that time. I gave my first paper at a UMAA Conference in Logan that year. It was titled, "Basics of Mosquito Control". I still have a copy of that. I was so nervous I could hardly talk. It was a humbling experience for me. Dr. George Knowlton was conducting that session. He was extremely supportive.

The Magna District has come a long way since those days with modern equipment and just recently a new facility. My office was in an old school house which had been moved up from Garfield. We had an old storage facility and garage, however, I was able to oversee the construction of a new vehicle storage building in 1967. In October of 1970 I was on my way home from work in a district vehicle when a drunk driver moving at over 50 miles per hour rear-ended my truck at a stop light and pushed me into another truck. I received only minor injuries, however, the truck driver died a few weeks later from injuries. I was very lucky and I was wearing my seat belt.

On May 1, 1973 I took over as manager of the Box Elder District replacing Karl Josephson who retired. This District not only does mosquito control but also has a fly spray program. A total of 28 seasonal employees were hired each summer. I was overwhelmed by the size of the district and the thousands of acres of potential mosquito producing areas. After the first season I was ready to quit. After the second season I was still ready to quit. The job was difficult during those two years. I developed an ulcer and high blood pressure, but grew to accept it as a challenge and eventually enjoyed managing the District. I set eight priority goals which I felt needed to be accomplished. One of those goals was to reduce the size of the crew. We now hire only 14 seasonal employees and get the same job done. This has been possible with a fleet of ATV's and more training.

With the support and cooperation from my Executive Board along with Gordon Wheeler, my assistant manager, and a dedicated staff, all of the goals were accomplished. Jody Shelley, our District Secretary, was instrumental in advancing us into the computer age. We have two modern computers and all our records including Payroll are now done on the computers.

During my years with the Box Elder District I have experienced a 30 minute battle with a large female rat. When cornered she came after me with barred teeth, however, I did win the battle. At the time I was in charge of insect and rodent control at the counties two nursing homes.

I have experienced a law suit that went on for five years, however, the most trying part of this was a 2½ hour deposition in front of 3 lawyers. We were cleared of any wrong doing. They asked me over 100 questions during the deposition. I know some of you have had this experience.

In 1974, two Environmental Protection Agency lawyers, unqualified for most things pertaining to chemicals and mosquito control, spent an entire day with me going over purchasing records, chemical inventory and whatever else they could think of. The reason for their unscheduled visit was 400 gallons of DDT which was purchased by the district in the late 60's and was stored at our agency. They took samples and issued me a stop use, stop sale and stop removal order from the EPA. None of it had been used since I had become manager. They left, never to be heard from again. The State Health Department helped us remove the DDT and take it to Salt Lake City for storage after permission was given by the EPA.

During the summer of 1979 we experienced a bristletail invasion in the Harper Ward area. Harper is just north of Brigham City. Millions of these flattened fish shaped insects invaded two homes in the area, covering homes, barns, fences, and driveways. It was incredible, almost unbelievable. I was called on a Saturday morning and told to do something about it. I called two employees into work and started ground spraying as well as with an aircraft to hit the mountain areas. We sprayed malathion by air and diazinon by ground. We killed millions but they just kept coming. It was a terrible nuisance for the people that lived there. You could shovel up piles of dead ones, and then they began to stink. The press and T.V. reporters were on the scene, in fact, it made the national news. For me it was a nightmare. The problem didn't stop until Gordon and I found the source approximately ½ mile up the mountain near an old mine shaft. They were following a water line and coming down the mountain like an army. You would never believe it unless you saw it. We treated the area with malathion and the migration stopped, almost overnight, and they were gone. I will never forget that experience.

Another time one of our operators got his vehicle stuck on the railroad tracks just west of Brigham City. The vehicle would not move. These tracks were the main line between Utah and Idaho. It took five men and two winches to get the truck off. One winch to pull and one to hold the truck up from tipping over. It took over two hours to accomplish the job. Within 20 minutes or less of getting the truck off, a freight train came by at over 65 miles per hour, even though we had called the railroad to warn them of the problem.

I am writing a book about my forty years in mosquito control. I have kept a daily log since 1962 and I thought it would be interesting for my children to have. The list could go on and on and you can see why I am getting tired after forty years.

I also directed the Weed Spray Program in 1993 and 1994. This program required a great deal of time and at times kept me away from my regular management responsibilities. I gave this up so that I could direct all of my time to mosquito control management. I'm still active on the

State Weed Board.

If I could give any advice to present-day managers it would be to keep accurate and up to date records, and to treat your employees with respect and patience. They are what makes it happen. They should be well trained and know how to deal with the public. That is more important now than ever before. Plan for the future and be prepared.

I have had a lot of help over the years from my Executive Board and many others, too many to mention because I might forget someone. Many of you are here and I thank you.

I would especially like to thank my good wife who not only was supportive but very patient with me when I would come home very stressed out and was not easy to get along with. Thank you.

THANKS FOR ALL YOUR SUPPORT.

Selling the Science of Insects

BETSY PRICE

The Natural History of Genes, Project Manager
University of Utah

If I were to venture into a career as a public relations agent, a client that was in insect management would not be my first choice. I would want to represent an animal that has a long neck, long legs, and a stomach far from the ground. Or, I would choose something furry. These are things that our culture regards as beautiful and appealing. For clients I would choose a rabbit that gazes sweetly out over clover fields, not the honeybee that may sting my nose. Animals like rabbits quickly gain the attention and curiosity of children and adults.

In our culture, those whose stomach is furthest from the ground is the most appealing. Danny Devito has little chance of taking the romantic lead away from Arnold Schwartzenegger. Bambi, Dumbo, and even Babe the pig have little to fear from a reptile at Oscar time. Insects, at best, are character actors, and more usually are the villains of the piece. They bring into the story what is terrible and evil. In reality, some of the insects, like the mosquito, deserve this image but some don't. It is the fuzzy understanding of the general public, who is the enemy and who is not, that challenges those who wish to manage insects.

If I were to represent an insect client, some changes would have to take place. Cher has had every part of her body moved to another part, Burt Reynolds wears a toupee and, according to my sources, every one of Robert Redford's teeth is capped. Dinosaurs, wisely, have spruced up their image recently and are now more appealing to the general public. Think about what can be done. Fur - put fur on anything and it is sure to be a crowd pleaser. Stuff an animal to make it soft and cuddly. Or, make it walk with flashing eyes. Think about one of the few insects to make it in the big time, Jimmy Cricket. To make him charming and delightful, his animators gave him a pair of legs, drew him upright, and gave him a neck.

There is no getting around it, insects and insect management are a tough sell to the general public. It is a dirty job, but someone has to do it. The importance of selling insect management to the blissfully ignorant has became very apparent in the post-DDT era as we have cleaned up the damage from society's attempt to eradicate all our fur-deficient, abdominally abominable, neckless friends. As a whole our attempts in the 1950's, 60's and 70's to tame Mother Nature have made us painfully aware that to manage our fragile ecosystem takes a public that is literate in science.

In the 1980's educators, on all academic levels, ventured forth on the arduous mission of bringing science to all Americans. The ecological challenge of the 1990's is to educate the public on which insects to spray, which not to spray, when to spray, what to spray, who should spray, and how to spray. These decisions require informed jurors who can make compromises with the environment that will allow us to live harmoniously with our beneficial insect friends and manage those insects that endanger the lives of their neighboring plants and animals. Once decisions are made, the action requires implementation by those who are knowledgeable about their trade and conscientious and cautious about their impact on nature, mankind, and themselves.

Science For All Americans - How Are We Doing?

Science education has become a priority in schools at all levels. Federal, state, and local governmental agencies, private industries and corporations, and philanthropic organizations have devoted money, time, and services to enhance science education in the schools and in teacher education. But, the goal of having all Americans literate in science has not yet been achieved.

Educators and critics of educators have given many reasons for this lack of progress and have begun the slow process of problem solving. But, the jobs of educators is to build the schools, supervise the professional and support staff, oversee the curriculum, and motivate and guide the students. They must rely on the scientific community to teach science to the teachers, provide guidance on curriculum content, and author textbooks and support materials.

Public schools also cannot be solely accountable for creating a scientific literate public because schools cannot educate those who have left the system. As our ecological conditions change with time it is doubtful that the dilemma can wait for the next group of students to come through the system's pipeline. There are other educational institutions, such as zoos, nature centers, and museums. There are also many popular mediums for reaching adults: television, newspapers, and popular and professional journals.

What Can Be Done?

Student Education In the Schools

UMAA members need to work with curriculum, textbooks, and information books that take insect biology, environmental ecology, and chemistry, and show how that knowledge is used to manage insect pests and preserve beneficial insects.

It is important that curriculum materials help students use the information learned for real-life problem solving. Most students believe what they learn in science class is different from what happens in real life. In science class they learn about the benefits of insects, but in the real world they are inundated with commercials, advertisements, and popular culture that portrays all insects as the enemy. Students will study about insects, but textbooks devote more print to describing the anatomy of insects (the body segments, the number of legs, antennae or no antennae) rather that the value of some insects and the dangers of others, and how insects can be managed.

Schools also need curriculum that specifically links the "what insects are" with the "what insects do," with their role in the ecosystem, and with their benefits and hazards to food production and to the quality of life they create for their plant and animal neighbors. Students must also understand the chemical properties of insecticides, how they work, and what happens to them once they are released in the ecosystem. They also need to understand the ecosystems, what are the natural and human controls of insects, and how natural control can be insufficient.

The second requirement of the curriculum is to promote activities that allow students to gain access to the natural world and that broaden how students perceive the world in which they live. Few students have seen a bee in a hive or have eaten honey from the comb. Honey is squeezed from a plastic bear. Few students have gathered seeds from plants. Seeds come from packages. When students do encounter insects it is because the insects are in a place they are not meant to be, as in a package of cereal or under the sink.

UMAA members can assist by helping students see and experience more of the natural world through field trips and outside activities. Curriculum must bring the outdoors in or take the students outside. Student involvement with the natural world can be laboratory experiments. For example, students can discover for themselves how pollination occurs in plants by hybridizing generations of plants in a home made greenhouse. Even in the city, students can plant gardens, or can visit an arboretum or local park to see insects at work.

<u>Science Teacher Education</u>

UMAA members need to give workshops for inservice teachers (those who have a teaching job) and preservice teachers (those aspiring to a job), to update the teachers' content knowledge and to provide them with interactive classroom activities.

In many teacher training institutions, elementary education majors are considered non-science majors and their science requirements are the same as those for major in communication, social work, and English. Over 80% of non-science majors will take biology in high school or in college, but most courses are large, introductory survey courses that serve a wide range of majors. Because of the large number of subjects an elementary teacher must be prepared to teach, few elementary teachers can devote time to take more science courses that what is required. Many secondary science teachers take the non-majors' science courses and do not have enough time to take as many elective science courses as they would like.

Teachers are wise consumers and will beat a path to the door of a workshop that provides curriculum and materials that are directly (this is the key word) applicable to the classroom. UMAA members need to find ways to reach education majors through their science courses or through their science methods courses from education departments. College courses need to be custom tailored to provide science content and pedagogy that will be directly (that key word again!) applicable to what is important and pertinent for a pre-college class. This can be accomplished by UMAA working with college science departments to present classes specifically designed for teachers. UMAA members can also offer to be guest teachers in science methods courses in order to help education majors transfer science content into interactive and interesting classroom lessons.

<u>The General Public.</u>

UMAA members can help with the curriculum for non-science majors in college and in high school. Most non-science majors (not only teachers) will take an introductory biology course to meet their general education requirements in college. For those not college bound, their last course in biology will most likely be general biology in high school. These courses will most often be their last exposure to a science classroom. The students' impression, interest, and understanding of science will be formed by these courses. Biology departments at the secondary and college level need to examine the course content, the students' attitude, and the students' ability to transfer knowledge to resource management, preservations of wildlife, and conservation. For example, students will typically memorize the parts of a flower, the segments of an insect, and the digestive system of a worm, but these students will typically not understand the relationship these organisms have to each other, and therefore to issues of importance in the lives of the students.

Another way UMAA can reach the general public is to cultivate alternative educational institutions and communication media in order to reach the general public. Schools can only reach those students who are still in the system. But nonformal institutions like nature centers, zoos, and museums do reach students, teachers, and parents. Many of these institutions cannot afford to have a scientific staff let alone an entomologist. UMAA can help institutions like these to design exhibits, programs, lecture series, and outreach kits. These can update content information for those out of school and expand school science for those still in science.

The lessons we have learned is that it takes a village or a family (choose your preferred metaphor), the community of educators and organizations to brings science to all Americans. Schools cannot work alone. Educators cannot work alone. Scientist cannot work alone. The best opportunity for the UMAA to help with educational programs is by capitalizing on the public interest and enthusiasm about attending programs at nonformal institutions. Most Americans get their science information from television, which has recently been mandated to provide more high quality programming for children. This opens the possibility for providing insect management programs into this time slot. Finally, the popularity of the Internet is making it cool to read, and provides a cost-effective and efficient way to reach all Americans. These media make it easy for students and non-students to learn, but also make it easier for UMAA to participate in science for all Americans.

Summary

UMAA members have many ways in which to reach the general public to become aware of the work that the organization does and how it is done. By participating in the development of curriculum or lessons for non-science majors courses, UMAA can reach those who will not get higher level science courses. By participating in nonformal education, UMAA can reach those (science majors or not) who have left the system of schools and need to be updated on information issues.

UMAA can work with the new regulations that have been mandated to television networks to provide quality programming and work with a new media, the Internet, to provide information that people can access at home and work.