University of California, Riverside Cooperative Extension

WaterWise

http://esce.ucr.edu

WINTER 2006 • VOL. 1, ISSUE 4 • A QUARTERLY PUBLICATION ADDRESSING WATER ISSUES

Landscape Pesticides and Surface Water Quality

Jay Gan[1], Cheryl Wilen[2], and Dennis Pittenger[3]

[1]Extension Water Quality Specialist, UCR, [2]Area Integrated Pest Management Advisor, UCCE San Diego County, and [3]Area Environmental Horticulturalist, UCR

Residential Landscapes and Pesticide Use

In the United States, home lawns occupy 20-25 million acres. Many residential landscapes also include non-turf systems such as ground covers, shrubs, trees, and mulches. In California alone it was last estimated that environmental horticulture occupied 1.4 million acres. Given the recent boom in new developments, the acreage of residential landscapes as of today may be substantially larger. Residential landscapes serve as the straight target of pesticides that are applied to home lawns and gardens and the first-tier buffer for pesticides applied around structures. Studies have shown that pesticide use in residential settings has contributed to contamination of urban surface streams by pesticides. Monitoring studies have shown that the movement of pesticides from residential areas is mainly associated with storm runoff.

Pesticide runoff potential is dependent on the relative persistence of the pesticide in the soil. The runoff risk of a persistent chemical is greater than that of a non-persistent compound, simply because the persistent pesticide has more time to be exposed to precipitation and storm runoff. While different pesticides are known to persist in soil for different lengths of time, it is also true that the persistence of the same pesticide may vary greatly in different soils. Studies show that pesticide persistence depends closely on soil chemical properties and microbial activity. Residential landscapes, unlike agricultural fields, are comprised of highly diversified plantings, such as turfgrass, trees, ground covers, shrubs, mulched areas, and bare surfaces. The heterogeneous planting may affect soil properties over time, thus influencing pesticide persistence and consequently pesticide runoff potential.

Figure 1. Mixed landscape plots at UC Riverside.

To understand how pesticides would behave differently in different landscape systems, we carried out a study to understand the effect of landscape planting covers on the persistence of two commonly used landscape herbicides, 2,4-D and dicamba. This study was published in the journal of *Environmental Sciences & Technology* (Gan et al., 2003, 37: 2775-2779). Here we present a brief recap of this study with the intention that information from studies such as this one may help us to identify strategies for minimizing pesticide runoff from residential areas to urban streams.

Study Design

In the study, we collected soil samples from a field located at the Agricultural Experiment Station on the University of California, Riverside campus. The field consisted of multiple 8 × 8 m plots with different planting covers that were originally established in 1995. All plots had received the same amount of fertilizer and pesticide treatment in the last 6 years prior to the sampling.

Soil samples were taken from tall fescue grass plots (grass), pear tree plots (tree), low- growing groundcover plots (groundcover), and mulched plots (mulch) (Figure 1). The degradation of 2,4-D and dicamba in the different landscape soils was determined by incubating spiked soil samples at 20 °C.

The soil organic matter content was found to differ significantly among the different landscaped soils. In the 0-10 cm surface layer, the organic matter content was the highest in the mulch soil (1.95%), which was followed by the groundcover soil (1.16%) and the grass (0.82%). The tree soil was the poorest with an organic matter content of only 0.35%. Apparently, in the mulch soil, incorporation and decomposition of bark and other woody materials contributed to the organic matter enrichment. In grass and groundcover soils, decomposition of plant detritus contributed to the increase. The very low organic mater content in the tree soil was caused by the lack of biomass accumulation on the soil surface over the years.

2,4-D

The herbicide 2,4-D was degraded at significantly different rates in the four soils, resulting in significantly different half-life ($T_{1/2}$, day), calculated as the time elapsed for 50% of the chemical to dissipate. The most rapid degradation occurred in the turf grass soil, in which 2,4-D decreased to a small fraction of the original concentration within 3 days after the treatment. Degradation of 2,4-D was also rapid in the groundcover and mulch soils. The slowest degradation occurred in the tree soil, where 2,4-D concentration decreased gradually over the first 28 days and then accelerated. The estimated $T_{1/2}$ was only 1.6 d for the turfgrass soil, and was also very short for the mulch ($T_{1/2}$ ~3.7 d) and groundcover ($T_{1/2}$ ~3.9 d) soils. However, in the tree soil, the $T_{1/2}$ of 2,4-D was prolonged to about one month (31 d) (see Figure 2).

To understand the mechanisms for the differences in 2,4-D persistence, we used a microbiological method to enumerate 2,4-D degrading bacteria in these soils. The mean population of 2,4-D degrading bacteria was found to be the highest for the turfgrass soil at 230,000 cells per gram of soil, which was followed by the mulch soil (49,000 cells per gram of soil) and groundcover soil (13,000 cells per gram of soil). In the tree soil, there were only about 2,300 cells of 2,4-D degrading microbes per gram of soil.

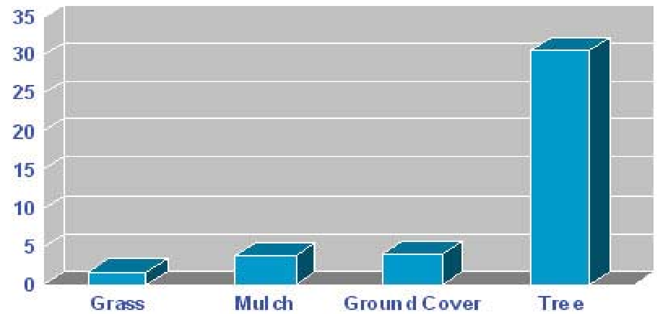

Figure 2. Half-lives of 2, 4-D in soils with different planting covers (days).

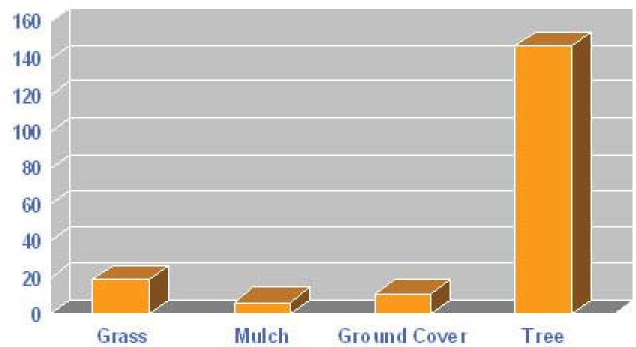

Figure 3. Half-lives of dicamba in soils with different planting covers (days).

Regression analysis showed that there was a highly significant linear correlation between the number of 2,4-D degraders in the soil and 2,4-D persistence. Therefore, the different planting practices changed the microbial communities in soil over time, which in turn influenced the persistence of 2,4-D.

Dicamba

The degradation of dicamba was generally slower than that of 2,4-D in the same soil. In the surface soils, the fastest degradation occurred in the mulch soil, which was followed by the groundcover soil and then the turf grass soil. The slowest degradation for dicamba was found with the tree soil. The estimated $T_{1/2}$ for dicamba was 7.9 d in the mulch soil, and increased to 11.2 d in the groundcover soil and 19.6 d in the grass soil. In the tree soil, dicamba had $T_{1/2}$ of about 150 d (see Figure 3).

We performed linear regression between dicamba's $T_{1/2}$ values with soil organic matter content, and found that there was an excellent inverse correlation between the persistence of dicamba and soil organic matter content. Soil organic matter supports the growth of soil microorganisms and contains a great number of chemically active functional groups. Therefore, the different planting covers appeared to have changed the soil organic matter over time, which in turn influenced the persistence of dicamba.

Implications

This study showed that landscape planting covers played a critical role in controlling the persistence of both 2,4-D and dicamba in soil. After about 6 years, the soil chemical and microbial properties became significantly different under the different planting covers. Of all the landscaped systems tested, herbicide persistence was consistently prolonged in the soil from the tree landscape, which had low organic matter content and low density of herbicide degrading microorganisms. Therefore, under conducive conditions, higher runoff risks may be expected for 2,4-D and dicamba in landscape systems dominated with trees and/or bushes.

Dependence of pesticide persistence on planting covers may be used for city planners, developers, landscape architects, and professional landscapers for designing landscapes that are more resistant to pesticide runoff. For instance, grass strips placed at property boarders may effectively intercept and then degrade the trapped pesticides. In contrast, planting trees or bushes at the lower border of slopes will unlikely serve any mitigation purpose. Such information may be also used for educating the general public (e.g., homeowners) for reduced or guided pesticide use in sensitive planting systems. For instance, pesticides applied to slopes planted with trees or bushes will have the greatest runoff potential and such application should be avoided or performed with caution.

Perchlorate Pollution and Iodine Nutrition

David M. Crohn
Biosystems Engineering Specialist

Perchlorate (ClO_4^-) is a water pollutant that can potentially interfere with thyroid function. In both human and animal studies, it was shown to amplify thyroid problems in those who are iodine deficient. Scientific consensus is that children of pregnant and nursing mothers with low levels of dietary iodine represent the population most susceptible to perchlorate problems (NRC 2005).

By competitively interfering with the thyroid's ability to concentrate iodine from the bloodstream, perchlorate limits the production of thyroid hormones (TH). These hormones are vital for fetus and infant health. TH shortages in infants can permanently impair their learning abilities and neuromotor skills.

In adults, low TH levels can result in symptoms of hypothyroidism, which may include sluggishness, depression, dry skin and hair, weight gain, muscle cramps, constipation, or goiter. Perchlorate is not usually a significant problem for either adults or infants with adequate iodine in their diet since enough is still absorbed by the thyroid to meet the body's hormone production needs.

At least two other compounds common in the American diet, nitrate and thiocyanate, can also interfere with iodine collection. Nitrate, the most widely occurring groundwater pollutant, results from over-fertilization with nitrogen fertilizer or manures. Thiocyanate occurs naturally in certain vegetables such as broccoli, cauliflower, cabbage, turnips, brussels sprouts, or mustard seeds. Although perchlorate interferes more strongly with thyroid function than thiocyanate or nitrate, these last two compounds are more common in the diets of most people.

Iodine deficiency is the world's leading cause of avoidable intellectual impairment. Though permanent, most damage is mild to moderate, but it can also be severe, depending on the timing and intensity of the deficiency. Typical iodine consumption in the United States has fallen significantly since the early 1970s (Caldwell et al. 2005), leading to concerns that iodine deficiency problems in the public at large, and particularly nursing mothers, may be increasing (Kirk et al. 2005). This decrease in iodine intake in the United States is likely associated with changes in the manufacturing of bread and milk that have lowered their iodine contents. In addition, processed foods, which have become more popular, frequently are manufactured with non-iodized salts (Pearce et al. 2004).

Exposure to Perchlorate

Perchlorate is found in solid fuels used to power high energy devices such as rockets, flares, fireworks, and airbags. Perchlorate pollution is usually traceable to rocket fuel manufacturing or disposal, though it also occurs naturally.

Once in the environment, perchlorate is quite water soluble and washes readily through soils along with other salts and can accumulate in groundwater. Perchlorate also accumulates in fresh vegetables, such as lettuce, if they are irrigated with polluted water, so the mechanisms for exposure include both water and food (OEHHA2004, Kirk et al. 2005). An additional route of exposure for infants is that perchlorate appears to concentrate in breast milk (Kirk et al. 2005).

Recent improvements in the ability to detect perchlorate at low concentrations have revealed widespread contamination of both water and irrigated vegetables. The Environmental Protection Agency (EPA) has detected elevated perchlorate levels in drinking water (>4 parts per billion (ppb)) at some 400 locations in 35 states (NRC 2005), the majority in California and Texas (GAO 2005). Today over 11 million people have perchlorate in their drinking water at or above its standard detection threshold of 4 ppb but as of yet no national drinking water standard is in place.

Regulators across the United States are currently trying to agree on what is a safe perchlorate intake level. Government estimates of safe perchlorate concentrations in drinking water range from 1 ppb in Massachusetts to 6 ppb in California to 24.5 ppb nationally (GAO 2005). The differences between the proposed limits are largely due to different approaches to correcting for the inevitable uncertainties that result when conclusions based on human and animal studies are applied to the general population. Corrections are intended to protect the most vulnerable populations of fetuses, infants and pregnant women, although effects of perchlorate on this population have not been directly studied (GAO 2005).

Other differences arise from assumptions regarding the occurrence of perchlorate in foods, about which information is limited. The presence of perchlorate in foods is currently under study by the Food and Drug Administration (Hogue 2005).

Protect Your Health

Fortunately, it is quite easy to protect your health from perchlorate. At concentrations normally encountered in the diet, perchlorate does not appear to reduce thyroid hormone production in people consuming adequate iodine.

The recommended dietary allowance (RDA) for iodine is 150 micrograms/day for most adults. Children, who are smaller, require less iodine, while pregnant and nursing mothers need more (see Table 1). A teaspoon of Morton Iodized Salt contains about 400 micrograms of iodine so 3/8 of a teaspoon would meet the iodine needs of a typical adult. A little more than a half teaspoon would be adequate for a pregnant woman while three-fourths of a teaspoon of iodized salt would be adequate for nursing mothers. It is possible that RDA values may one day be revised upward as our understanding of the role of perchlorate in thyroid health evolves (Kirk et al. 2005), but reasonable use of iodized salt in cooking and seasoning should meet these needs. Dietary iodine can also come from meat products, and to a lesser extent, vegetables.

Too much iodine is also unhealthy. Note that routine ingestion of excessive iodine can also lead to problems including hypothyroidism, goiter, or thyroid papillary cancer. For iodine, the Tolerable Upper Intake Level (UL), the highest level of daily intake that is considered to be safe, is set at 1100 micrograms per day for adults with lower amounts for children and teens (Table 1).

Consumers should be aware that it is easy to exceed the UL if seaweed is used as a food or supplement (Teas et al. 2004). Hypothyroidism in newborn and nursing infants in Japan has been linked to mothers consuming seaweed containing from 2300 to 3200 micrograms iodine per day (Nishiyama et al. 2004).

If you are susceptible to perchlorate, your iodine intake level is already too low. This concern can be controlled by assuring that an adequate amount of iodine is in your diet. Check to see that your salt is iodized (or choose a low-dose supplement or prudent amounts of sea vegetables).

Iodine is important for health, perchlorate or no perchlorate. Thus, educating the public about iodine nutrition should be a central focus of all perchlorate management efforts.

Table 1. Iodine Recommended Dietary Allowances (RDA), Adequate Intakes (AI) and Tolerable Upper Intake Levels (UL). From Panel on Micronutrients (2000).

Age and Status	RDA/AI (micrograms)	UL (micrograms)
Infants, 0 – 6 months	110 (AI)	Not determined
Infants, 6 – 12 months	130 (AI)	Not determined
Children, 1 – 3 years	90	200
Children, 4 – 8	90	300
Children, 9 – 13	120	600
Adolescents, 14 – 18	150	900
Adults, > 18	150	1100
Pregnant adolescents, ≤ 18	220	900
Pregnant adults, > 18	220	1100
Nursing mothers, ≤ 18	290	900
Nursing mothers, > 18	290	1100

References

Caldwell KL, Jones R, Hollowell JG (2005). Urinary Iodine Concentration: United States National Health and Nutrition Examination Survey 2001–2002. Thyroid. 15:692-699.

GAO (2005). Perchlorate: a system to track sampling and cleanup results is needed. United States Government Accountability Office. Report to the Chairman, Subcommittee on Environment and Hazardous Materials, Committee on Energy and

Commerce, House of Representatives. GAO-05-462.

Hogue C (2005) Federal policy on perchlorate evolves: EPA, FDA, and military continue work on assessing and cleaning up contaminant. Chemical and Engineering News. Sept. 21.

Kirk AB, Martinelango PK, Tian K, Dutta A, Smith EE, Dasgupta PK (2005) Perchlorate and iodide indairy and breast milk. Environ Sci Technol. 39:2011-2017.

Nishiyama S, Mikeda T, Okada T, Nakamura K, Kotani T, Hishinuma A (2004) Transient hypothyroidism or persistent hyperthyrotropinemia in neonates born to mothers with excessive iodine intake. Thyoroid 14:1077-1083.

NRC (2005) Health implications of perchlorate ingestion. National Research Council of the National Academies. National Academies Press. Washington, D.C.

OEHHA (2004) Public health goal for perchlorate in drinking water. California Environmental Protection Agency. Office of Environmental Health Hazard Assessment. Sacramento.

Please see POLLUTION, page 7

Local Governments and Environmental Compliance: Lessons for Extending Environmental Regulation to Agriculture

W. Bowman Cutter
Assistant Water Resource Management Specialist

Agricultural operations are increasingly subject to the same kinds of pollution regulation that many other businesses have been subject to for two decades or more. The regulatory challenge posed by agricultural pollution is similar to that posed by small businesses generating hazardous wastes in that both generate small amounts of pollutions individually but in the aggregate they can generate significant amounts of pollution.[1] Because each operation on its own poses small environmental risks, the costs of regulating each business in terms of lost work time and production may not always justify the benefits. Regulation needs to be carefully structured to achieve pollution reduction goals while not being overly burdensome to business. California has restructured its regulation of small hazardous-waste generating business over the last decade by defining the state and local role so as to use the strengths of both levels of government. The successes and failures of this restructuring provide important lessons for the regulation of agricultural operations.

Until 1993, the public response to problems of hazardous waste management in California was incomplete and fragmented. The prior approach was a poorly designed system of delegation and decentralization to local governments. Under the overlapping jurisdiction of the State Water Quality Control Board, the Department of Toxic Substances Control, and California EPA (CalEPA), over 1300 local government agencies had fragmented jurisdictions (CalEPA 2001). Businesses faced overlapping and sometimes contradictory requirements from the different jurisdictions.

In 1993, then Governor Pete Wilson signed legislation to consolidate the major hazardous waste regulatory programs into one agency for each responsible local government. The same bill also required a second reform, that the local agencies replace the various fees used in the major programs with a single fee that is only expected to cover the costs of the program and must satisfy several fee accountability provisions. In addition, the local agencies were required to consolidate and coordinate inspections for the different elements of the hazardous waste programs. Both the single-fee and inspection consolidation requirements were instituted to save business-owners time and expense. But neither requirement compromises the pollution reduction goals.

Who Should Run Local Regulation?

The hazardous waste restructuring envisioned a partnership where the state sets the basic rules on the conduct and frequency of inspections and enforcement and local governments have leeway within those rules to target problem areas and work with local business. This partnership assures the State that environmental regulations are being enforced, while still taking advantage of local jurisdictions' better knowledge of local conditions.

A key aspect of this partnership is the rules governing which jurisdictions would be allowed to run the program. The legislation originally intended all counties to have control of the program. However, it has been difficult to persuade some of the smaller rural counties to undertake the expense of setting up a unified pro-

• 1 Hazardous waste may conjure up images of spent nuclear fuel, but for most small businesses the hazardous waste they generate is more mundane waste such as used motor oil.

gram. By 2002, four years after the 1997 date, 14 counties still had not set up unified programs (CalEPA 2002). As of February 2005, seven years after the original deadline, all counties now have CUPA agencies. The difficulty of bringing the small, rural counties into the program reflects the problems small jurisdictions, cities as well as counties, have in setting up new regulatory administrative structures.

Within the umbrella of these hazardous waste programs, the leaking underground storage tanks (USTs) and hazardous waste generators (HWGs) pose challenges most similar to the regulation of agriculture. The majority of businesses in these programs individually generate small amounts of pollution. The inspection data for both USTs and HWGs indicate that the jurisdictions (the cities) that volunteered to run the programs are doing a better job overall. This is not surprising, since these jurisdictions had to jump though several hoops to prove their ability to run the program.

Over the entire period of CUPA operation for which we have data (1997-2003), cities conducted close to double the number of inspections that counties did (about 1.3 inspections/year for cities versus about .7 inspections/year by counties). For the recent period of FY 2001-2003, cities conducted approximately 1.3 inspections per year while counties have improved to .8 inspections per year. Since 2000, the state has required that localities inspect USTs at least annually. Since this requirement, on average cities have met the requirement 63% of the time while counties have only met the requirement 20% of the time. In the HWG program an examination of inspection rates again shows cities doing more than counties. Over FY 2001-3, cities average .66 inspections/facility per year while counties average .41.

This experience in hazardous waste regulation tells us that those jurisdictions which volunteer for regulatory reform can likely be trusted to carry out their responsibilities. There is also a cautionary note that when jurisdictions are required or mandated to carry out enforcement they may do a poor job. This is relevant to the efforts of the State and Regional Water Quality Boards as they seek to build a regulatory program for agricultural water quality. Involving local governments such as counties can be helpful in setting up a regulatory program, but there should be a process to select only qualified counties.

Funding

The single-fee funding structure is one of the more unusual parts of the program restructuring because state-mandated environmental programs so seldom include a funding mechanism. In this case, though the state sets limits on the use of the fees, they are explicitly authorized in statute. Therefore, jurisdictions that wish to raise sufficient funds to cover the costs of their hazardous waste programs have the legal ability to do so.

The existence of a fee that is legally separate from the general fund maintains a constant source of funding and therefore program activities. In contrast, if the fee either did not exist or went to the general fund, regulatory activities would likely be subject to the vicissitudes of the local revenue situation. One weakness of the fee structure is that, because there is no minimum fee, jurisdictions that have little political will to set sufficient fees may not have the funds to run an acceptable program. This may be an explanation for the low levels of inspection and enforcement seen in some counties.

Conclusion

California has managed to institute a successful hazardous waste management program that leverages local government capabilities while at the same time ensuring consistency across jurisdictions. A key lesson from this reform is that by allowing jurisdictions to volunteer to perform regulatory tasks, the State can pick out those jurisdictions that are likely to implement a successful program. Another lesson is that local responsibility must be accompanied by a funding mechanism. Without the single-fee funding mechanism, it is doubtful that the local jurisdictions would be able to mount vigorous regulatory programs. These lessons on how local governments can implement environmental regulations should be considered as the State considers how to cost-effectively manage its agricultural pollution problems.

References

California Environmental Protection Agency. Report to the Legislature: Certified Unified Program Agency (CUPA) Program Statewide Standards. 1-15. 3-1-2001. Sacramento, CA., The Agency.

California Environmental Protection Agency. Report to the Legislature: Status of Unified Program Implementation and the Rural CUPA Reimbursement Account. 1-21. 2-1-2002. Sacramento, California, California Environmental Protection Agency.

California Bureau of State Audits. Department of Toxic Substances Control: The Generator Fee Structure is Unfair, Recycling Efforts Require Improvement, and State and Local Agencies Need to Fully Implement the Program. 98027, 1-R-23. 6-1-1999. Sacramento: California State Auditor, Bureau of State Audits. California State Auditor Report.

Legislative Analyst's Office, 2001. Resources. Analysis of the 2000-01 Budget Bill. LAO, Sacramento, CA, pp. B-55-B-70.

Panel on Micronutrients (2000) Dietary reference intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc; A Report of the Panel on Micronutrients, Subcommittees on Upper Reference Levels of Nutrients and of Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and Nutrition Board, Institute of Medicine. National Academies Press. Washington, D.C.

Pearce EN, Pino S, He X, Bazrafshan HR, Lee SL, and Braverman LE (2004) Sources of dietary iodine: bread, cows' milk, and infant formula in the Boston area. J Clin Endocrinol Metab. 89:3421-3424.

Teas J, Pino S, Critchley A, Braverman LE (2004) Variability of iodine content in common commercially available edible seaweeds. Thyroid 14(10):836-841.

VISIT
http://esce.ucr.edu
Official web site of the Cooperative Extension Specialists in UCR's Department of Environmental Sciences

See electronic issues of WaterWise and other pertinent information

California Residents Want Local Officials to Support the Environment

Christine French[1] and
Laosheng Wu[2]
[1]Water Program Assistant
[2]Water Management Specialist

Californians support environmental protection and believe elected officials should place more emphasis on the environment. These are two of the many findings suggested by the results of a recent survey.

To assess public awareness, attitudes, and actions toward water quality, a 37-question survey was adapted by the USDA-CSREES Southwest States and Pacific Islands Regional Water Quality Program Team from a similar survey used in the Pacific Northwest. Results from the California portion of the survey are being used to help water quality educators understand public perceptions of water quality issues.

The survey was mailed to 2000 randomly selected California residents and responses gathered from December 2003 to July 2004. The survey was completed by 988 residents for a response rate of 49%. The collected data were analyzed using the SAS procedure at the University of Idaho, and have a sampling error of +/- 5 percent. Survey questions were divided into the following sections: 1) How do you feel about the environment? 2) Your Environmental Perspective, 3) Water Issues, 4) Water Quality Education, 5) Governance, and 6) Demographics.

Californians Believe in Environmental Protection

Residents were asked how they viewed themselves on environmental issues on a scale from 1 to 10. A value of 1 indicates that all natural resources should be used freely, while a value of 10 indicates that all natural resources should be protected and not used by humans. A value of 5 indicates an equal balance between resource use and resource protection.

The average ranking of all California residents who completed this survey was 6.2. For comparison, the average ranking of Arizona residents was 5.7 and 5.6 for Nevadans. The demographic factors of length of residency in the state, age, and education also impacted the response to this question. Demographic factors of community size and gender did not show any significant differences.

Residents in the 40-49 age group were most likely to favor resource protection and gave themselves an average rating of 6.5 (Figure 1). Both younger and older residents leaned slightly toward more balance, but were still clearly on the side of resource protection.

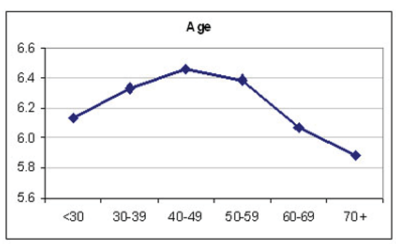

Figure 1. The influence of age on how respondents balance natural resource use and protection.

Education level had a significant impact on how respondents viewed natural resource use (Figure 2). Respondents who did not complete high school were the demographic group with the lowest ranking (5.9) although they still favor resource protection over resource use. Respondents with an advanced degree matched the rating of the 40-49 age group at 6.5, strongly in favor of resource protection.

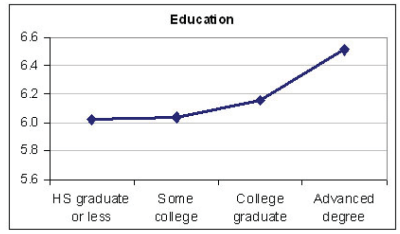

Figure 2. The influence of education on how respondents balance natural resource use and protection.

Residents who have lived in California less than ten years were more likely to favor resource protection (6.5) than life-long residents (6.0) (Figure 3).

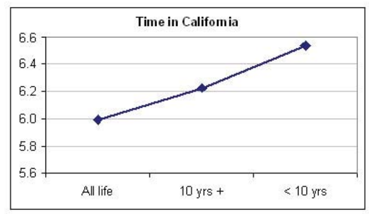

Figure 3. The influence of length of residence in California on how respondents balance natural resource use and protection.

Californians Favor State/ Local Control of Water Quality

While residents generally favor environmental protection, they are split on which levels of government should provide that protection. When asked who *should* be most responsible for protecting water quality, 42% of survey respondents said the state government, while 32% favored responsibility at the county, city, or town level. Only 12% thought the federal government should be most responsible. Another 7% thought individual citizens should take responsibility for their local waters while the remaining 7% either didn't know, or had other suggestions.

In regard to whether or not local government and elected officials in the state give the right amount of emphasis to the environment, responses varied significantly based on gender, age, education, and length of residency. Community size did not significantly impact the response.

Overall, 41% of Californians do not believe there is enough emphasis on environmental issues by their elected officials, while 15% believe there is too much (Figure 4). Females (Figure 4), all age groups under 60 (Figure 5), residents who have earned college or advanced degrees (Figure 6), and residents who have lived in the state either all their lives or less than ten years (Figure 7) all represent demographic groups above the state average, ranging from 43 – 51%, who would like to see more emphasis placed on the environment. Of all demographic groups, residents in the 60-69 age group are most likely (at 35%) to feel the emphasis is about right.

Additional information about the results of this survey can be found online at http://www.waterresources.ucr.edu/index.php?content=wqp/projects_info/wqp_proj_info.htm#survey.

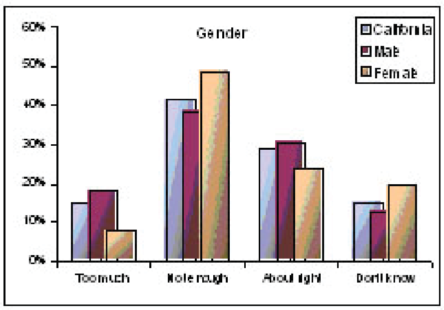

Figure 4. The influence of gender on residents' opinion of environmental emphasis in the state.

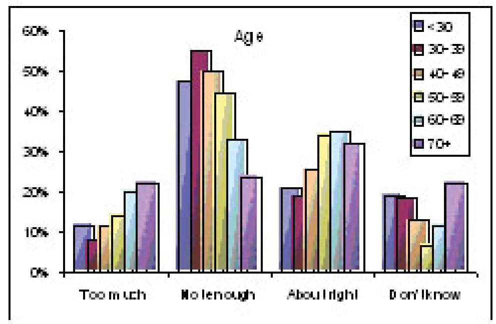

Figure 5. The influence of age on residents' opinion of environmental emphasis in the state.

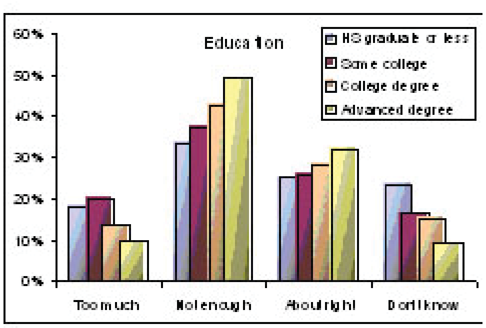

Figure 6. The influence of education on residents' opinion of environmental emphasis in the state.

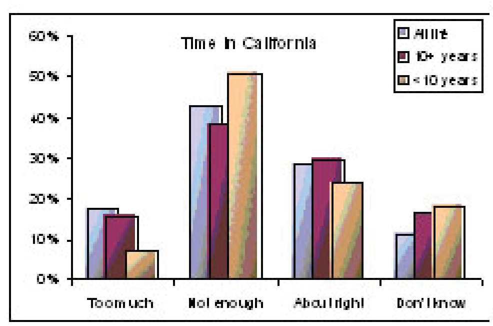

Figure 7. The influence of length residence in CA on residents' opinion of environmental emphasis in the state.

WaterWise is published quarterly by Dr. W. Bowman Cutter, University of California Cooperative Extension (UCCE) Water Resource Management Specialist and Editor; Dr. David M. Crohn, UCCE Biosystems Engineering Specialist and Chair Waste Management Workgroup; Dr. Jay Gan, UCCE Water Quality Specialist; and Dr. Laosheng Wu, UCCE Water Management Specialist. The newsletter is edited by Dr. Bo Cutter with the assistance of Christine French**.** The intent of the publication is to disseminate summaries of research results and topics of interest in water management and environmental sciences to UCCE Farm Advisors and Specialists, UC faculty, personnel in government agencies, and industry clientele. Please address comments and correspondence to Dr. Bo Cutter, *WaterWise* Editor, via e-mail (bowmanc@citrus.ucr.edu), by telephone (951) 827-2088, by fax (951) 827-3993, or by mail addressed to him in the Department of Environmental Sciences, University of California, Riverside, CA 92521. *WaterWise* is issued in furtherance of Cooperative Extension work, Acts of May 8, 1914 and June 30, 1914, in cooperation with the United

Dr. W. Bowman Cutter
Assistant Water Resource Management Specialist

bowmanc@citrus.ucr.edu (951) 827-2088

Dr. David M. Crohn
Extension Biosystems Engineer

crohn@mail.ucr.edu (951) 827-3333

Dr. Jay Gan
Water Quality Specialist

jgan@mail.ucr.edu (951) 827-2712

Dr. Laosheng Wu
Water Management Specialist

laowu@mail.ucr.edu (951) 827-4664

Do You Know?


David Crohn

Dr. David M. Crohn is a Cooperative Extension Biosystems Engineer and Waste Management Specialist in the Department of Environmental Sciences, University of California, Riverside (UCR). His research emphasizes composting, nutrient management of land-applied wastes, and the use of constructed wetlands to improve water quality. Dr. Crohn chairs Cooperative Extension's statewide Waste Management Workgroup.


Bowman Cutter

Dr. W. Bowman Cutter is a Cooperative Extension Assistant Water Resource Management Specialist in UCR's Department of Environmental Sciences and Editor of ***WaterWise*.** His current research focuses on cost-effective water pollution regulation and urban water supply, water quality issues, and public policy.


Jay Gan

Dr. Jay Gan is a Cooperative Extension Water Quality Specialist in UCR's Department of Environmental Sciences who has expertise in the environmental fate and transport of organic contaminants, especially pesticides. His current research focus is assessment and mitigation of pesticide pollution in surface and ground water resources.


Laosheng Wu

Dr. Laosheng Wu is a Cooperative Extension Water Management Specialist in the UCR Department of Environmental Sciences whose current research focuses on irrigation, water and salinity management, water quality issues, and interaction of soil physical and chemical properties. He also serves as the associate director of the UC Center for Water Resources, a statewide center based in Riverside.