Department of Pesticide Regulation
Environmental Monitoring and Pest Management
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Protocol for Identifying Areas of Ground Water Vulnerability in California Phase II: Model Testing

I. Background

In the first phase of this study, we developed a technique to profile areas vulnerable to ground water contamination by pesticides (Troiano et al., 1992). Groups of known vulnerable (KV) sections were identified using statistical clustering methods of climatic and soil data and then described using Principal Components Analysis. For soil data, five clusters were identified using two soil variables, one reflecting soil texture and one indicating the absence or presence of a hardpan. The average soil texture of the five clusters was diverse ranging from coarse (sandy) to fine (clayey) (Table 1). The average hardpan indicator of the five clusters ranged from practically no soils in a section with a hardpan to potentially all soils in a section with a hardpan (Table 1).

A profiling method based on the soil clustering results was derived for determining cluster membership or nonmembership of candidate sections into KV clusters. All sections in Fresno county with soil data were profiled and subjected to the soil cluster classification algorithm. When the results of the classification were graphed, three important features were observed (Figure 1):

1. When plotted, the statistical clusters formed discrete geographical areas. A large area of coarse, sandy soil was located in the central portion of Fresno county (see cluster 1, Table 1 and Figure 1). Adjacent to it on the east were sections that were relatively coarse in texture but with the additional feature of having a hardpan which extended into Tulare county (see cluster 2, Table 1 and Figure 1).

2. Not all candidate sections were classified into one of the KV section clusters. This indicated that the algorithm was not restricted to data provided by KV sections and that it could potentially differentiate between a larger set of soil profiles.

3. The sections not-classified into one of the KV clusters were spatially located near the edges of the clusters. As one might expect, the farther apart sections were located geographically, the less similar they were in soil properties. This was another indication that the method identified geographical areas with unique soil characteristics.

The objective of the study described in this protocol is to determine if the candidate sections classified into KV clusters also have detectable levels of pesticide residues in well water samples. To accomplish this objective, wells will be sampled in candidate sections in Fresno and Tulare Counties. Wells will be sampled from the predominant KV clusters identified in this area which are designated as KV1 and KV2 in Table 1. Wells will also be sampled from sections that were not classified into one of the KV clusters (see Figure 1).

II. Personnel

The project will be conducted by the Environmental Hazards Assessment Program under the general supervision of Kean S. Goh, Ag Prog. Sup IV. Other key personnel include:

Project Leader: John Troiano
Senior Scientist: Bruce Johnson
Statistician: Terri Barry
Field coordinator: Craig Nordmark
Laboratory Liaison: Nancy Miller
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III. Objective

The objective is to test the results of the profiling model by analyzing data from additional well sampling that will be conducted in sections identified as members of known vulnerable soil clusters and also in sections not yet identified as similar to one of the known vulnerable soil clusters. The data will be compared to determine if differences are present in the occurrence of contaminated well water samples between the groups.

IV. Study Design

A maximum of sixty wells, one per candidate section, will be sampled in each of two KV clusters (Table 1): 60 wells in KV1 cluster, the coarse-textured and no hardpan cluster; and 60 wells in KV2 cluster, the coarse- to medium-textured cluster that had approximately 50% of the soils in a section containing a hardpan. Sixty wells will also be sampled in sections that were not classified into one of the KV clusters (Figure 1). Candidate sections in Fresno and Tulare counties will be selected for sampling based on pesticide use and cropping patterns. The detection history, cropping patterns, and pesticide use of vulnerable sections that formed the core of known vulnerable clusters will be compiled. Candidate sections with similar cropping and pesticide use profiles will be identified for possible well water sampling. If potential sample sizes are large enough for each category, wells will be chosen randomly for sampling, otherwise, the sample size may be limited to available sites. Known vulnerable sections, on which the clustering analysis was conducted, will not be included in the sampling.

V. Well Sampling

Wells will be sampled according to established procedures.

VI. Chemical Analyses

It is anticipated that samples will be analyzed for the following known leachers; atrazine, bromacil, diuron, prometon, and simazine. Also dacthal and its breakdown products MTP and TPA will be included because TPA had been detected in well water and it was used in the development of the KV vulnerable clusters. Since the occurrence of breakdown products also is an indicator of previous use in a section and subsequent contamination of ground water, the analyses will include the triazine breakdown products DEA and DIPA. Data for cyanazine, hexazinone, metribuzin, and prometryn will also be collected because they are normally included as part of the analytical screen. Chemical methods are established for these active ingredients and breakdown products. Normal quality control procedures will be followed. Alta Analytical laboratory will screen samples for atrazine, bromacil, cyanazine, DEA, DIPA,.diuron, hexazinone, metribuzin, prometryn, prometon and simazine with positive results confirmed by CAL LABS laboratory. CDFA will be the primary laboratory for dacthal, MTP, and TPA analysis with positive results confirmed by APPL laboratory. Blind spike samples will be periodically submitted to all laboratories.

VII. Statistical Analysis

Logistic regression will be used to measure potential differences in the proportion of positive wells detected in each category. Three contrasts will be made: one contrast to measure potential differences in the proportion of positives between candidate sections in the two known vulnerable clusters and the not classified sections; a second contrast to measure potential differences between the two known vulnerable clusters; and a third contrast to measure potential differences in positive detections between sections with highe and low total reported use of the ground water contaminants .

VIII. References

Troiano, J., B. Johnson, S. Powell, and S. Schoenig. 1992. Profiling areas vulnerable to ground water contamination by pesticides in California. Final report to the U.S. Environmental Protection Agency for contract #E-009565-01-0. Environmental Monitoring and Pest Management Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA 95816. EH 92-09.

Table 1. Description and average±standard deviation (SD) sectional values for variables that reflect the presence of hardpan and % soil particles passing a No. 200 soil sieve in each of 5 clusters of sections vulnerable to ground water contamination by pesticides.

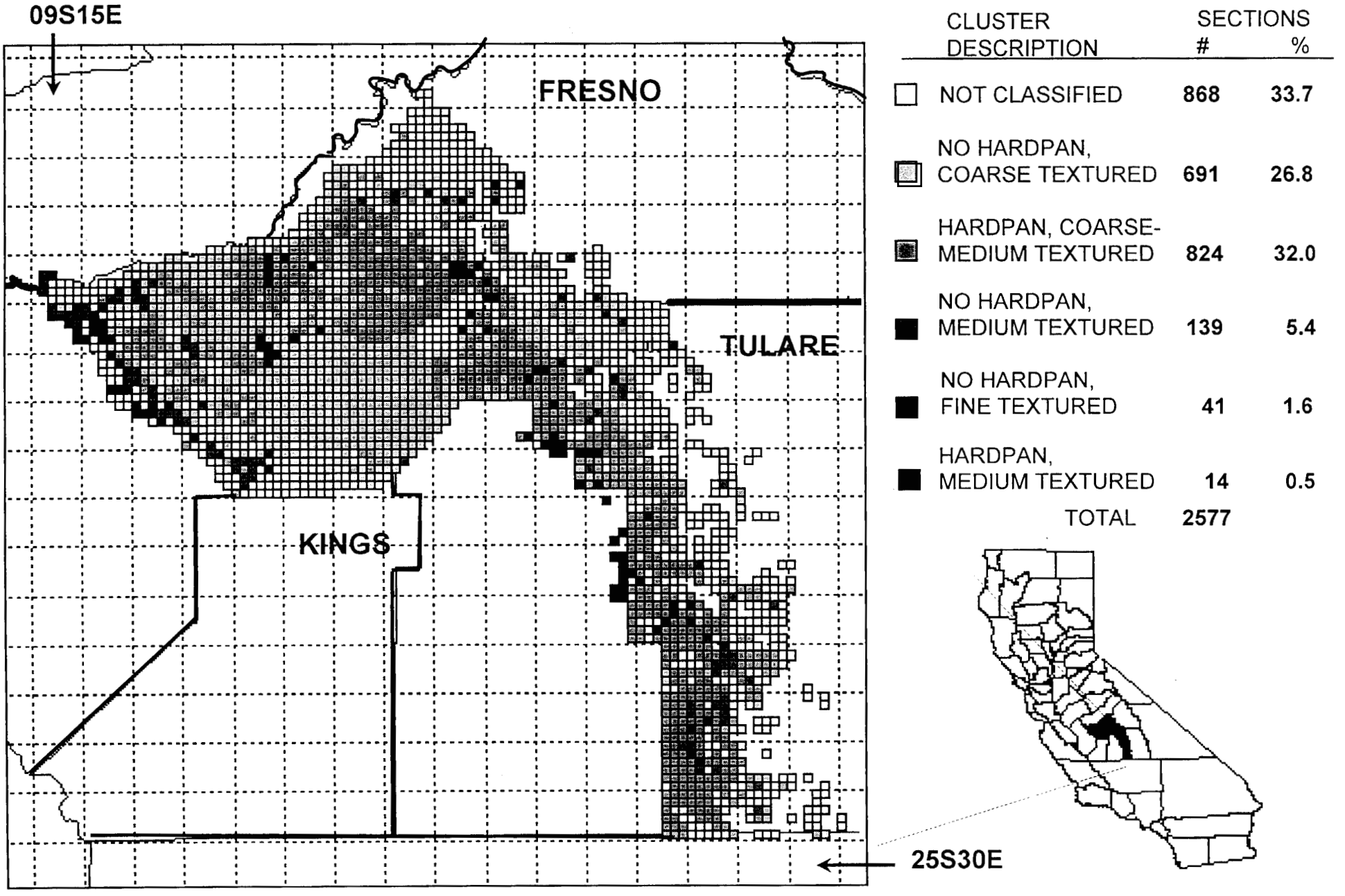
Cluster Description	# of KV Sections	Cluster Variables		Distribution of Pesticide AIs in each cluster§						
		Hardpan†	No. 200 Sieve‡	Atra	Ben	Bro	Diu	Pro	Sim	TPA
		-------%-------		----------# of Sections----------						
KV1. No Hardpan and Coarse Textured	72	0.08±0.11	35.5±5.9	5	3	10	23	2	63	4
KV2. Hardpan and Coarse-Medium Textured	82	0.50±0.14	49.3±7.7	4	6	36	56	3	67	1
KV3. No Hardpan and Medium Textured	26	0.01±0.03	59.6±6.4	6	9	1	2	0	6	9
KV4. Hardpan and Medium Textured	26	0.94±0.13	61.9±10.1	2	4	12	16	3	20	0
KV5. No Hardpan and Fine Textured	48	0.03±0.10	81.7±4.3	17	25	0	0	4	7	0

† Scale from 0-1 with a 0 value representing no soils in section with hardpan and a 1 indicating all soils in that section with hardpan.

‡ Measured by the percentage by weight of soil particles that pass a No. 200 soil sieve. The smaller the percentage, the more coarse textured the soil.

§ Atra=Atrazine; Ben=Bentazon; Bro=Bromacil; Diu=Diuron; Pro=Prometon; Sim=Simazine; TPA=breakdown product of dacthal.

Figure 1. Classification of sections in Fresno and Tulare Counties into soil vulnerability clusters for ground water contamination by pesticides.



CLUSTER DESCRIPTION	SECTIONS #	%
NOT CLASSIFIED	868	33.7
NO HARDPAN, COARSE TEXTURED	691	26.8
HARDPAN, COARSE-MEDIUM TEXTURED	824	32.0
NO HARDPAN, MEDIUM TEXTURED	139	5.4
NO HARDPAN, FINE TEXTURED	41	1.6
HARDPAN, MEDIUM TEXTURED	14	0.5
TOTAL	2577	