F1-150

I. EXECUTIVE SUMMARY

DWR MAILROOM

of the proposal entitled 97 JUL 28 PM 1:36

Development of Management Practices to Reduce Diazinon and Chlorpyrifos Levels in the Bay-Delta System of California

Submitted by
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In 1988, scientists from the Central Valley Regional Water Quality Control Board (CVRWQCB) in California began testing water quality in the San Joaquin River (SJR) watershed using bioassays. The CVRWQCB conducted these tests to characterize water quality in the SJR, its tributaries and drains, and to identify sources of toxicity seen in bioassays (Connor, 1988). Results indicated waters from certain regions of the watershed caused significant mortality to the water flea, *Ceriodaphnia dubia* (Foe and Connor, 1991). The specific cause of toxicity was not determined, but was attributed to pesticides in general.

During the winter of 1991-92, grab samples collected from the SJR watershed were again found to be toxic to *C. dubia*; chorpyrifos and diazinon were implicated as potential causes of toxicity (Foe and Sheipline, 1993). During the winters of 1991-92 and 1992-93, the Department of Pesticide Regulation (DPR) conducted monitoring in the watershed for various organophosphate and carbamate insecticides. Ross et al. (1996) found some samples contained chlorpyrifos, some contained diazinon, and some contained methidathion. In addition, some of these samples exceeded the *C. dubia* LC_{50} for chlorpyrifos, diazinon, and methidathion. Therefore, insecticide concentrations measured in grab samples imply that acutely toxic conditions may exist in the watershed.

Chlorpyrifos, diazinon, and methidathion are used as dormant sprays during the rainy season to control over-wintering pests in nut and stone fruit crops, important agricultural commodities in California. Control of off-target movement of these insecticides may be critical for preserving water quality and the health of the aquatic system. Therefore, the overall goals of the project are to (1) complete development of farm management practices (e.g., vegetative and mulched buffer zones in commercial orchards) designed to reduce the movement of these insecticides from orchards during the rainy season, (2) use a watershed model to determine if resultant reductions in insecticide runoff from orchards will enable us to meet water quality goals in the basin, and (3) monitor a small watershed using new management practices to determine if modeled results can be corroborated and water quality goals achieved.

In phase one of the proposed work, field studies will be completed in commercial orchards in the SJR watershed region to test the effectiveness of vegetative and mulched buffer zones in reducing insecticide runoff. The tasks of consulting with growers, locating fields, installing equipment, validating chemical analytical methods, and collecting and analyzing samples are scheduled for May 1998 through April 1999. In phase two, we plan to use field results that indicate a reduction in insecticide runoff in a non-point source runoff model to predict changes in watershed concentrations. Modeled results also will be compared with actual measurements made in a small watershed where the new management practices have been implemented. Tasks scheduled for January 1998 through June 2000 include: model selection; model installation, calibration, and sensitivity analysis; GIS database check and digitizing; GIS database acquisition; and model/GIS runs using field data. In phase three, we will measure pesticide concentrations from actual fields in a small watershed where the new management practices will be implemented. These tasks include identifying cooperating growers and locating fields, installing equipment, collecting and chemically analyzing samples, and conducting toxicity tests. These activities are scheduled for May 1999 to April 2000. In phase four, we plan to prepare the final report by December 2000.

Chlorpyrifos and diazinon are both listed as insecticides of concern to the CALFED Bay-Delta Working Group. The SJR is one of two major river systems feeding fresh water into the Delta. It is also a major source of diazinon in the Delta in winter months (Kuivila and Foe, 1995). Reducing concentrations and mass of insecticides in runoff from orchards will lower concentrations in the Delta, and diminish the potential harm these insecticides pose to resident aquatic organisms.

The total budget for this project is $826,017: $252,684 for phase one; $172,899 for phase two; $398,434 for phase three, and $2,000 for phase four. We request $743,415 from CALFED; DPR plans to supply $82,602 in matching funds. Growers and pest control advisors in the SJR and Sacramento River watersheds may experience economic impacts as a result of this study.

DPR's Environmental Monitoring and Pest Management Branch designs field investigations of management practices to reduce pesticide runoff for a variety of cropping systems and several different pesticides. DPR is currently conducting field investigations of management practices that reduce insecticide runoff during the dormant spay season. Already completed are (1) soil incorporation test plot comparisons with conventional practices (field work completed in the summer, 1996), (2) a clover versus oat cover crop study in an experimental peach orchard completed in the winter, 1996), and (3) a project in a commercial almond orchard to investigate the effectiveness of a clover cover crop versus native weeds (to be completed by spring, 1997). Results from these investigations and additional field work in plots at the commercial scale will be used in modeling efforts. Our staff has the education, training, and experience to successfully complete such a project (see attached vitae and lists of publications).

To date, soil incorporation and a clover cover crop reduce insecticide runoff compared with bare or grass-covered soils. We plan to measure levels of insecticides in runoff from vegetative and mulched buffers to evaluate how well these management practices reduce insecticide levels in runoff. DPR plans to enlist grower participation by providing small grants to cover the cost of implementing the new management techniques. In addition, the California Department of Fish and Game will conduct toxicity tests on water samples to determine if the CVRWQCB's water quality objectives are being met. Results will ultimately be used to make recommendations to the agricultural community in the SJR and Sacramento River watershed regions concerning management practices effective for controlling insecticide runoff from orchards. We expect that voluntary use of these management practices will result in levels of insecticides that meet water quality objectives; if objectives are not met, then DPR may implement regulatory-based programs using these management practices.

The CALFED Water Quality Program's goal is to provide good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses. The water quality program includes programmatic actions to reduce water quality degradation from agricultural drainage, urban and industrial runoff, and other sources. This project's purpose is to develop management practices to reduce agricultural, non-point sources of several pesticides that are contaminants of concern to the CALFED Bay Delta Program in watersheds that this program has identified as geographically important.

II. TITLE PAGE

Project Title:	Development of Management Practices to Reduce Diazinon and Chlorpyrifos Levels in the Bay-Delta System of California
Principal Investigator:	Lisa Ross, Ph. D. Senior Environmental Research Scientist Environmental Monitoring and Pest Management Branch
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RFP Project Group Type:	Other Services
Proposed Project Duration:	Three years (January 1998 - December 2000)
Proposed Budget:	$826,017 CALFED funds: $743,415 DPR matching funds: $ 82,602

III. PROJECT DESCRIPTION

a. Project Description and Approach

In 1988, scientists from the CVRWQCB in California began testing water quality in the SJR watershed using bioassays. The purpose of these tests was to characterize water quality in the SJR, its tributaries and drains, and to identify sources of toxicity seen in bioassays (Connor, 1988). Results indicated waters from certain regions of the watershed caused significant mortality to the water flea, *Ceriodaphnia dubia* (Foe and Connor, 1991). The specific cause of toxicity was not determined, but was attributed to pesticides in general.

During the winter of 1991-92, grab samples collected from the SJR watershed were again found to be toxic to *C. dubia*; chlorpyrifos and diazinon were implicated as potential causes of toxicity (Foe and Sheipline, 1993). During the winters of 1991-92 and 1992-93, DPR conducted monitoring in the watershed for various organophosphate and carbamate insecticides. Ross et al. (1996) found 10, 72, and 18% of the 108 samples collected contained chlorpyrifos, diazinon, and methidathion, respectively. These insecticides are used to control over-wintering pests in nut and stone fruit orchards. In addition, 2, 13, and 1% of these samples exceeded the *C. dubia* LC_{50} for chlorpyrifos, diazinon, and methidathion, respectively. The *C. dubia* LC_{50} values for chlorpyrifos, diazinon, and methidathion are 0.49, 0.11, and 2.2 μg/L, respectively (Fujimura, 1993). Therefore, insecticide concentrations measured in grab samples imply that acutely toxic conditions may exist in this watershed.

In winter months, peak insecticide residues in the SJR coincide with rain events (Figures 3 and 4, Ross et al., 1996). In addition, lagrangian surveys conducted during these periods indicate the insecticides have multiple sources in the watershed (Figure 12, Ross et al., 1996), somewhat consistent with their widespread use and physico-chemical properties (Ross et al., 1996). Duration of peak residues varies with storm events and from year to year (Figures 3 and 4, Ross et al., 1996) indicating a potential for chronic toxicity in this watershed as well.

In addition, data from the CVRWQCB and the U.S. Geological Survey indicate chronic toxicity may also occur. *C. dubia* mortality was found on 12 consecutive days in the SJR (Kuivila and Foe, 1995). Diazinon was detected in all 12 samples at concentrations ranging from 0.148 to 1.07 μg/L. The 4-day chronic criterion recommended by the California Department of Fish and Game for diazinon is 0.04 μg/L, not to be exceeded more than once every three years (Menconi and Cox, 1994).

A number of studies have examined pesticide runoff from agricultural sources (Wauchope, 1978; Leonard, 1990; Wauchope et al., 1990; Spencer et al., 1985; Ross and Sava, 1986; Ross et al., 1989). For most pesticides, runoff losses are 0.5% or less of applied amounts, unless several rainfalls occur within one to two weeks of application (Wauchope, 1978). Preliminary work by Ross and et al. (1997) in the SJR basin indicates less than 1% of the diazinon applied to almond orchards leaves the field after one rain event. Although seemingly small, the mass of material leaving individual orchards, combined with other orchards in heavy use areas, can potentially contribute enough residue to the aquatic system to cause toxicity in bioassay tests (Kuivila and Foe, 1995). Ecological effects in this watershed have not yet been linked with pesticide residues; however, the potential for such effects is implied through bioassay results and LC_{50} values for native species reported in the literature.

Much is not known about reducing pesticide runoff in orchards during rain events. Although similarities may exist with other types of crops, orchard management differs. In addition, conditions in a semi-arid environment, e.g., the San Joaquin Valley, are also important to consider. For example, certain permanent cover crops may create large water demand that could be expensive to maintain in areas of limited water supplies. In addition, on-farm ponding tehniques used in other crops (Ross and Sava, 1986, Ross et al., 1989) are not ideal for almonds since the soil must be well drained to prevent root rot. Therefore, the specific needs of nut and stone fruit production must be considered when developing practices that will be implemented by the agricultural community.

Long-range improvement in water quality is important for improving and maintaining the health of the aquatic system. Chlorpyrifos, diazinon, and methidathion are used as dormant sprays during the rainy season to control over-wintering pests in fruit and nut crops, important agricultural commodities in California. If farm practices can be developed to reduce insecticide runoff, then water quality might potentially improve (given current use patterns). Therefore, the overall goals of the project are to: (1) complete the development of farm management practices designed to reduce the movement of these insecticides from orchards during the rainy season, namely investigation of vegetative and mulched buffer zones in commercial orchards, (2) use a watershed model to determine if resultant reductions in insecticide runoff from orchards will enable us to meet water quality goals in the basin, and (3) monitor a small watershed using new management practices.

b. Geographic Boundaries of the Project

This project will be conducted in the SJR watershed region and includes the following counties: San Joaquin, Stanislaus, and Merced.

c. Expected Benefits

Increased contaminants (chlorpryifos and diazinon) have impacted water quality in the SJR and its tributaries, resulting in acute or potential chronic toxicity caused by agricultural, non-point source runoff. Chlorpyrifos and diazinon are both listed as insecticides of concern to the CALFED Bay-Delta Working Group. The SJR is one of two major river systems feeding fresh water into the Delta. It is also a major source of diazinon in the Delta in winter months (Kuivila and Foe, 1995). Reducing concentrations and mass of insecticides in runoff from orchards will lead to lower concentrations in the Delta, and therefore diminish the potential harm these insecticides pose to resident aquatic organisms. Furthermore, DPR plans to promote the use of the management practices developed in this study to growers in the SJR and the Sacramento River watershed regions. DPR's *California Pesticide Management Plan for Water Quality* (Duncan et al., 1997) outlines voluntary activities that use such management practices. If voluntary activities do not reduce levels of these insecticides to meet water quality objectives, then DPR may implement regulatory-based programs that use these management practices.

The use of best management practices developed through this proposal to restore water quality will also produce secondary benefits that include sediment reduction and improved infiltration in orchards with cover crops. By using cover crops to promote sediment reduction and improve infiltration, the proposal uses natural processes and functions as a means to restore water quality.

d. Background and Biological/Technical Justification

Research involving reduction of pesticide runoff has included, but is not limited to, bioremediation, soil management, and irrigation management techniques (Anderson and Coats, 1995; Saurer and Daniel, 1987; Kenimer et al., 1989). Vegetative filter strips and cover crops have met with some success, particularly with pesticides of relatively high absorption (Fawcett et al., 1992). Soil incorporation after application has reduced runoff of soil applied herbicides after simulated rainfall (Baker and Laflen, 1979). Irrigation management techniques that include shortening furrow lengths could potentially be useful during rain events. However, these may be difficult to implement in established orchards since they involve trenching, a procedure that may destroy root structure of young and established trees.

Due to repeated acute toxicity found during winter months and potential chronic toxicity problems the dormant spray insecticides may pose, it is appropriate that mitigation measures be taken to protect water quality. In addition, specific mitigation measures must be compatible with nut and stone fruit production. Therefore, in the first phase of this study we will examine insecticide runoff from almond orchards using various management practices.

However, simply knowing edge-of-field concentrations is not sufficient when the goal is to protect water quality in a watershed. Therefore, the second and third phases of this study are to (2) use a non-point source model, integrated with a geographical information system (GIS), and (3) have growers use these practices in a small watershed to determine if reductions seen at the edge of fields actually translate into water quality improvements.

Currently, DPR has conducted the following field investigations into management practices to reduce insecticide runoff during the dormant spray season: (1) soil incorporation test plot comparisons with conventional practices (field work completed in the summer, 1996); (2) a clover vs. oat cover crop study in an experimental orchard (completed in winter, 1996), and (3) a large scale project in a commercial almond orchard investigating the effectiveness of a clover crop versus native weeds (to be completed spring, 1997). Results from these investigations and additional field work in plots at the commercial scale will be used in modeling efforts.

e. Proposed Scope of Work

Phase one – field-testing management practices: Field studies will be completed in commercial orchards to test the effectiveness of vegetative and mulched buffer zones in reducing insecticide runoff.
Experimental design. Treatments will be set up in an orchard(s) using an appropriate statistical design.
Application. A single application of all three insecticides (chlorpyrifos, diazinon, and methidathion) will be applied at the same rate. The initial concentration of each insecticide applied will be determined from a tank mix sample.
Meteorological data. DPR staff will collect meteorological data; at a minimum, temperature and rainfall will be collected at the site using a Met-One® weather system and a Texas Instruments tipping rain bucket, respectively. Data will be recorded using a Campbell CR10 or 21X data logger operated with a 12-volt, deep-cycle battery.

Mass runoff and water sampling. To determine the mass runoff of each insecticide, the volume of rain runoff must be determined. Rain runoff volume from each treatment will be measured using a 75-mm flume equipped with a still well, housing a pressure transducer. Each pressure transducer will be connected to a Campbell 21X data logger to continuously monitor water height in the flume. Water height will be converted to volume using calculations experimentally determined by Clemmens et al. (1984). Water samples will be automatically collected when water flow is detected in the flumes by a sample activator. Water samples will be collected using an ISCO®-automated water sampler operated with a 12-volt, deep-cycle battery. During rain events (after application), water will be collected at specific intervals, evenly spaced to cover the entire runoff event, whenever possible. The number of water samples required to cover each runoff period will vary depending on rain intensity and duration, field dimensions, soil type, and other factors. Whole water samples will be analyzed. Filtered water samples may also be analyzed. In addition a backup sample will be collected for each sample analyzed.
Chemical analytical methods and quality control. Chemical analysis will be performed by the California Department of Food and Agriculture Laboratory. Method development and validation work will be conducted in accordance with Standard Operating Procedure QAQC001.00 (Standard Operating Procedure, 1995) prior to study commencement. Continuing quality control also will be conducted in accordance with the Standard Operating Procedure.
Soil properties. Soil texture and organic carbon will be determined. Soil texture will be determined using the hydrometer method (Bouyoucos, 1962) and soil organic matter by dichromate reduction with silver sulfate (Rauschkolb, 1980).

The tasks of consulting with growers, locating fields, installing equipment, validating chemical analytical methods, collecting and analyzing samples are scheduled for May 1998 through April 1999. Personnel = $71,994; Indirect costs (overhead) = $22,872; chemical analysis = $155,250; Pper diem and vehicle mileage = $2,568. **TOTAL = $252,684.**

Phase two – modeling: We plan to use field results that indicate a reduction in insecticide runoff in a non-point source runoff model to predict changes in watershed concentrations. Modeled results will be compared with actual measurements made in a small watershed where the new management practices have been implemented.

Runoff concentrations and mass measured in phase one will be used in a runoff model/Geographic Information System (GIS) integrated system to predict concentrations in the watershed. The Agricultural Non-Point Source (AGNPS) runoff model (Young et al., 1989), along with ArcInfo's GIS grid procedures, will be integrated to predict concentrations that could potentially be found in the watershed should any of these practices be implemented. The GIS will be used to input various pesticide use patterns, slopes, soil types, rainfall patterns, and cropping patterns.

To calibrate the model/GIS system, an evaluation of historical watershed concentrations is warranted. This evaluation will include an assessment of total pesticide use and total crop area in each hydrologic unit area of the watershed. Data required to perform this technique include initial pesticide mass or concentration per unit area [already known from preliminary field studies (Ross et al., 1996 and 1997)], pesticidal properties (e.g., soil adsorption and solubility), the number of acres treated in each hydrologic unit area, and geographic features such as flow path distance to the tributary sampled and elevation.

In addition, soil data will be summarized on a hydrologic unit area basis to determine if soil type influences runoff of certain pesticides. For example, runoff in areas where soils have high erosion potential may carry higher loads of pesticides that have a high soil adsorption constant than areas with low soil erosion potential. If these areas can be defined, pesticide use in those areas can be restricted based on the water solubility and soil affinity of the pesticide.

For the modeling/GIS system, the following information will be necessary:

1. Major watershed boundaries for the SJR system. This information is currently available from the U.S. Geological Survey in Sacramento.

2. Hydrologic boundaries for each unit area in the watershed. The boundaries on the west side of the SJR are complete, for the most part. Boundaries on the east side, however, are not. They may be available in AutoCad format from the individual irrigation districts.

3. Soils data from the Natural Resources Conservation Service for the watershed area.

4. Pesticide use data from 1992-1996 (or most recent three years available at DPR).

5. Physico-chemical properties of diazinon, chlorpyrifos and methidathon (available in the literature).

6. Rainfall data and concentrations (available at DPR).

7. Digital elevation model data (available at DPR).

8. Land use data (available at DPR).

It is expected that these management practices will significantly reduce runoff of these insecticides. These runoff values will then be used in the model, along with our GIS and pesticide use databases and historic discharge data, to predict insecticide concentrations in the watershed.

Tasks scheduled for January 1998 through June 2000 include: model selection, installation, calibration, and sensitivity analysis; GIS database check and digitizing; GIS database acquisitions, model/GIS runs using field data, and model runs to compare predicted values with measured values in the river. Personnel = $131,213; Indirect costs = $41,686. **TOTAL = $172,899.**

Phase three - implementing management practices in a small watershed and measuring insecticide levels in the river: We will measure pesticide concentrations from actual fields in a small watershed where the new management practices will be implemented.

Working with the county Agricultural Commissioners, we will contact growers willing to implement these farm management practices in a small watershed in the SJR watershed region. We plan to offer small "participation grants" to cover the cost of implementing the new management techniques, and plan to have about ten growers participate.

Specific tasks will be similar to those described above for phase one. About half of the growers will implement a vegetative buffer zone and half will implement a mulched buffer zone; rain runoff and river water samples will be collected, along with meteorological data and soil properties. In addition, the Department of Fish and Game will conduct toxicity tests on selected water samples. The tasks to implement this goal include identifying cooperating growers and locating fields, providing participation grants, installing equipment, collecting and conducting chemical analyses, and toxicity testing. These tasks are scheduled for May 1999 to April 2000. Personnel = $71,994; Indirect costs = $22,872; Chemical Analysis = $96,000; Toxicity tests = $175,000; Participation grants = $30,000; Per diem and vehicle mileage = $2,568. **TOTAL = $398,434.**

Phase four - final report: We plan to prepare a final report from June to December 2000. Print costs = $2,000. **TOTAL = $2,000.**

TOTAL FOR FOUR PHASES: $252,684 + 172,899 + 398,434 + $2,000 = $826,017. DPR will provide $82,602; we are requesting $743,415 from CALFED.

We plan to provide brief, quarterly technical and financial summary status reports on this project in the following schedule (assuming a starting date of January 1998): March 30, June 30, September 30, and December 30, 1998; March 30, June 30, September 30, and December 30, 1999; March 30, June 30, and September 30, 2000. By December 30, 2000, we will provide the final report.

f. Monitoring and Data Evaluation

To date, soil incorporation and a clover cover crop reduce insecticide levels in runoff compared with bare or grass-covered soils. We plan to measure levels of insecticides in runoff from vegetative and mulched buffers to evaluate how well these management practices reduce insecticide levels in runoff. DPR plans to enlist grower participation by providing small grants to cover the cost of implementing the new management techniques. In addition, the California Department of Fish and Game (DFG) will conduct toxicity tests on water samples to determine if the CVRWQCB's water quality objectives are being met. Results will ultimately be used to make recommendations to the agricultural community concerning management practices effective for controlling insecticide runoff from orchards.

Opportunities to coordinate evaluation of these results exist with the county Agricultural Commissioners, CVRWQB, and DFG.

g. Implementability

DPR routinely conducts studies that evaluate best management practices to reduce pesticide levels in various environmental media. We have worked in this watershed previously and, in cooperation with the county Agricultural Commissioners, have found growers willing to participate in such studies. Our work is conducted in compliance with the federal and state laws and regulations governing pesticide sales and use. Appropriate permits, if required, are obtained from the county Agricultural Commissioner.

h. References

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IV. COSTS AND SCHEDULE TO IMPLEMENT PROPOSAL

a. Budget Costs

Category	Total Cost
Phase One - Field Testing of Management Practices	
Direct Salary and Benefit Costs:	
1 Sr. Env. Res. Scientist (50%, 1044 hr/yr, x 1 yr)	$ 38,088
2 Assoc. Env. Res. Scientists (ea. @ 25%, 522 hr/yr, x 1 yr)	33,906
TOTAL SALARY	**$ 71,994**
Indirect Overhead Labor Costs (@31.77%)	**$ 22,872**
Service Contract: Chemical Analysis	**$155,250**
Other Direct Costs:	
Travel	
Per diem ($120/day x 5 days x 3 people)	1,800
Vehicle mileage (@24¢/mi)	768
TOTAL OTHER DIRECT COSTS	**$ 2,568**
Phase Two - Modeling	
Direct Salary and Benefit Costs:	
2 Sr. Env. Res. Scientists (ea. @ 30%, 626 hr/yr, x 2.5 yr)	114,260
1 Assoc. Env. Res. Scientist (10%, 209 hr/yr, x 2.5 yr)	16,953
TOTAL SALARY	**$131,213**
Indirect Overhead Labor Costs (@31.77%)	**$ 41,686**
Phase Three - Implementing Management Practices in the Watershed/Measuring Levels of Insecticides in the River	
Direct Salary and Benefit Costs:	
1 Sr. Env. Res. Scientist (50%, 1044 hr/yr, x 1 yr)	38,088
2 Assoc. Env. Res. Scientists (ea. @ 25%, 522 hr/yr, x 1 yr)	33,906
TOTAL SALARY	**$ 71,994**
Indirect Overhead Labor Costs (@31.77%)	**$ 22,872**
Service Contracts:	
Chemical Analysis	96,000
Toxicity Tests	175,000
TOTAL SERVICE CONTRACTS	**$271,000**
Other Direct Costs:	
Participation Grants (10 grants x $300 ea)	30,000
Travel	
Per diem ($120/day x 5 days x 3 people)	1,800
Vehicle mileage (@24¢/mi)	768
TOTAL OTHER DIRECT COSTS	**$ 32,568**
Phase Four - Final Report	
Costs of Materials/Acquisition Contracts: Printing	**$ 2,000**

TOTAL STUDY COSTS: **$826,017**

Matching funds from Department of Pesticide Regulation: $ 82,602
Funds requested from CALFED: $743,415

See Table 1 for a cost breakdown in each of the budget categories. Funding sources will be CALFED except for matching funds ($82,602) from DPR for the category of direct salary and benefits. All budget categories are O&M except direct salary and benefits and overhead.

Table 1. Breakdown of costs in budget categories.

Project Phase and Task	Direct Labor Hours	Direct Salary and Benefits	Overhead Labor (General, Admin and Fee)	Service Contracts	Material and Acquisition Contracts	Miscellaneous and other Direct Costs	Total Cost
Phase 1	1,566	$ 71,994	$22,872	$155,250	0	$2,568	$252,684
Phase 2	2,088	$131,213	$41,686	0	0	0	$172,899
Phase 3	1,566	$ 71,994	$22,872	$271,000	0	$32,568	$398,434
Phase 4	0	0	0	0	$2,000	0	$ 2,000

These funds will enable DPR to evaluate additional management practices to reduce insecticide levels in the Bay-Delta system. DPR has not allocated funds to evaluate these additional management practices. The potential for incremental funding exists: if phase three is not funded at this time, the study will still yield useful, though incomplete, information.

b. Schedule Milestones

Phase one: field-testing management practices

Specific Task	Start Date	Completion
Grower consultations	May 1998	June 1998
Field location	July 1998	August 1998
Equipment installation	November 1998	December 1998
Sample collection	January 1999	March 1999
Chemical method validation	September 1998	December 1998
Chemical analysis	January 1999	April 1999

Phase two: modeling

Specific Task	Start Date	Completion
Model selection	January 1998	June 1998
GIS database check and digitizing	January 1998	June 1998
Model installation, calibration and sensitivity analysis	July 1998	December 1998
GIS database acquisition	January 1999	June 1999
Model/GIS runs using field data	July 1999	December 1999
Model/GIS runs comparing modeling data vs. watershed data	April 2000	June 2000

Phase three: watershed implementation and monitoring

Specific Task	Start Date	Completion
Grower consultations	May 1999	June 1999
Field locations	July 1999	August 1999
Equipment installation	November 1999	December 1999
Sample Collection	January 2000	March 2000
Chemical Analysis	January 2000	April 2000

Phase four: final report

Specific Task	Start Date	Completion
Prepare final report	July 2000	December 2000

DPR would prefer the payments to be made on a quarterly basis over the three-year period. This would suit the project needs better than payment on a task-completion basis; all staff would be employed full time regardless of the task phase.

c. Third Party Impacts

The activities of growers and pest control advisors in the SJR and Sacramento River watersheds may experience economic impacts as a result of this study. These groups may be the targets of voluntary activities, or perhaps regulatory-based activities, to meet water quality objectives in these waters. These groups may also be the targets of educational programs and revised training programs.

V. Applicant Qualifications

Project Manager:	Dr. Lisa Ross, Senior Environmental Research Scientist *Department of Pesticide Regulation* Environmental Monitoring and Pest Management Branch
Modeler:	Dr. Bruce Johnson, Senior Environmental Research Scientist Department of Pesticide Regulation Environmental Monitoring and Pest Management Branch
Collaborator:	Mr. Brian Finlayson, Chief Department of Fish and Game Pesticides Investigation Unit

See attached resumes (Attachments one, two, and three) for more information.

Project Assistants:	Associate Environmental Research Scientists. These individuals will be assigned to this project from permanent staff of the Environmental Monitoring and Pest Management Branch's field group that routinely works on such projects.

VI. Compliance with Standard Terms and Conditions

A Non-discrimination Compliance Statement is attached (Attachment four). The terms and conditions are agreeable to, and are able to be complied with, by DPR.

I-003338

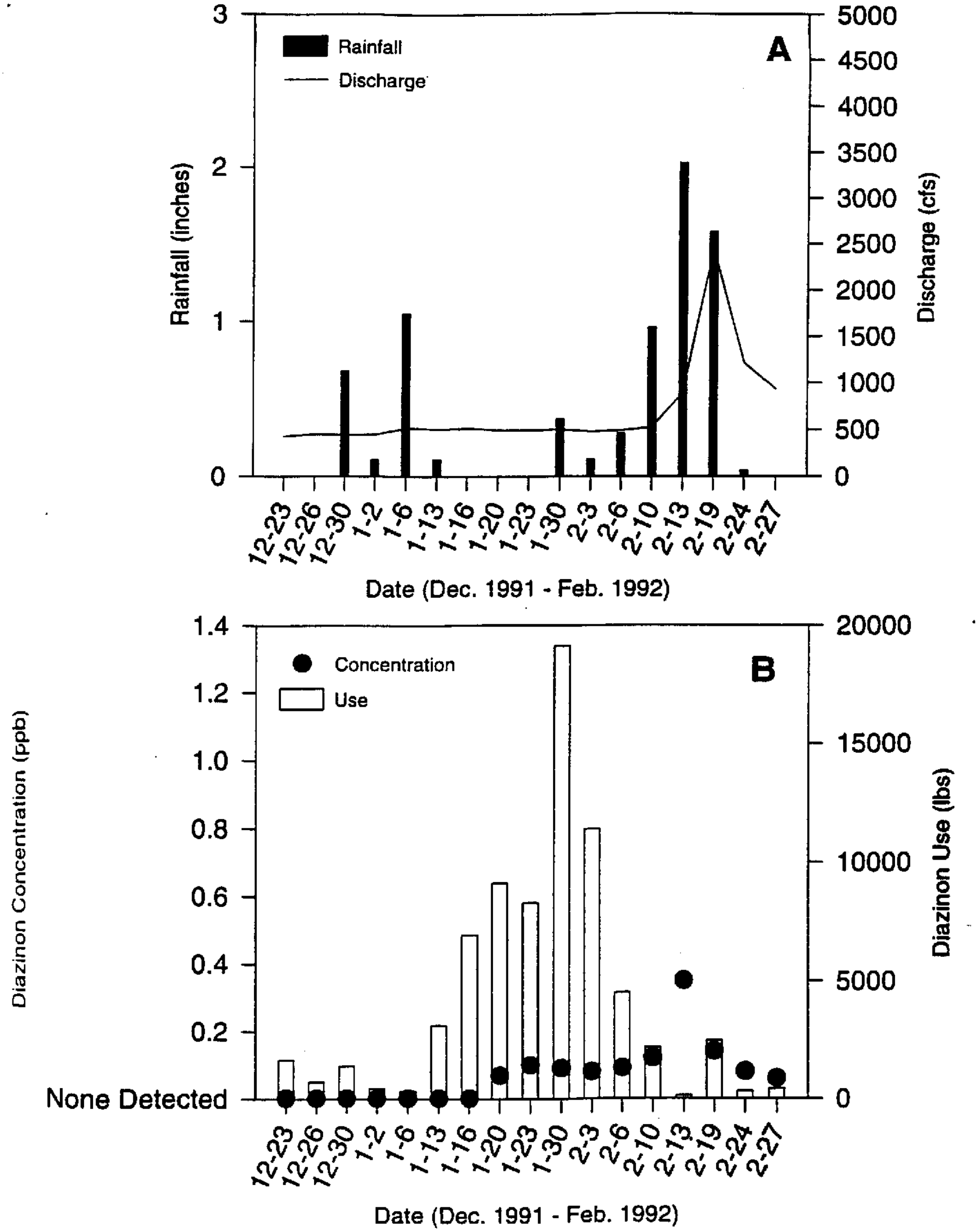

Figure 3. Data collected during the 1991-92 winter season. (A) Rainfall recorded at Modesto and discharge measured at Laird Park (site 12). (B) Diazinon concentrations from Laird Park and use reported in Merced and Stanislaus counties. Rainfall and diazinon use are summed between sampling intervals.

(From Ross et al., 1996)

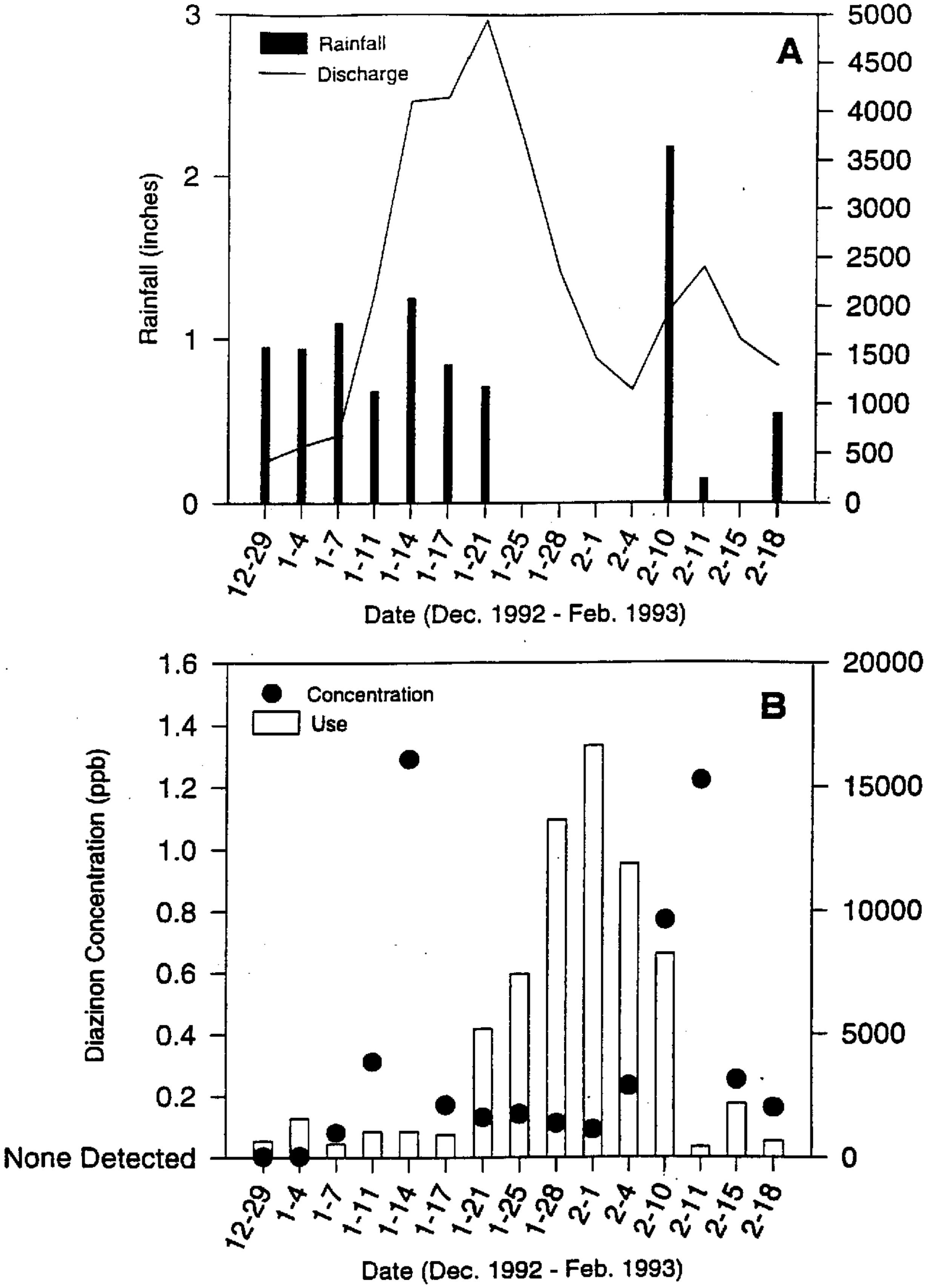

Figure 4. Data collected during the 1992-93 winter season. (A) Rainfall recorded at Modesto and discharge measured at Laird Park (site 12). (B) Diazinon concentrations from Laird Park and use reported in Merced and Stanislaus counties. Rainfall and diazinon use are summed between sampling intervals.
(From Ross et al., 1996)

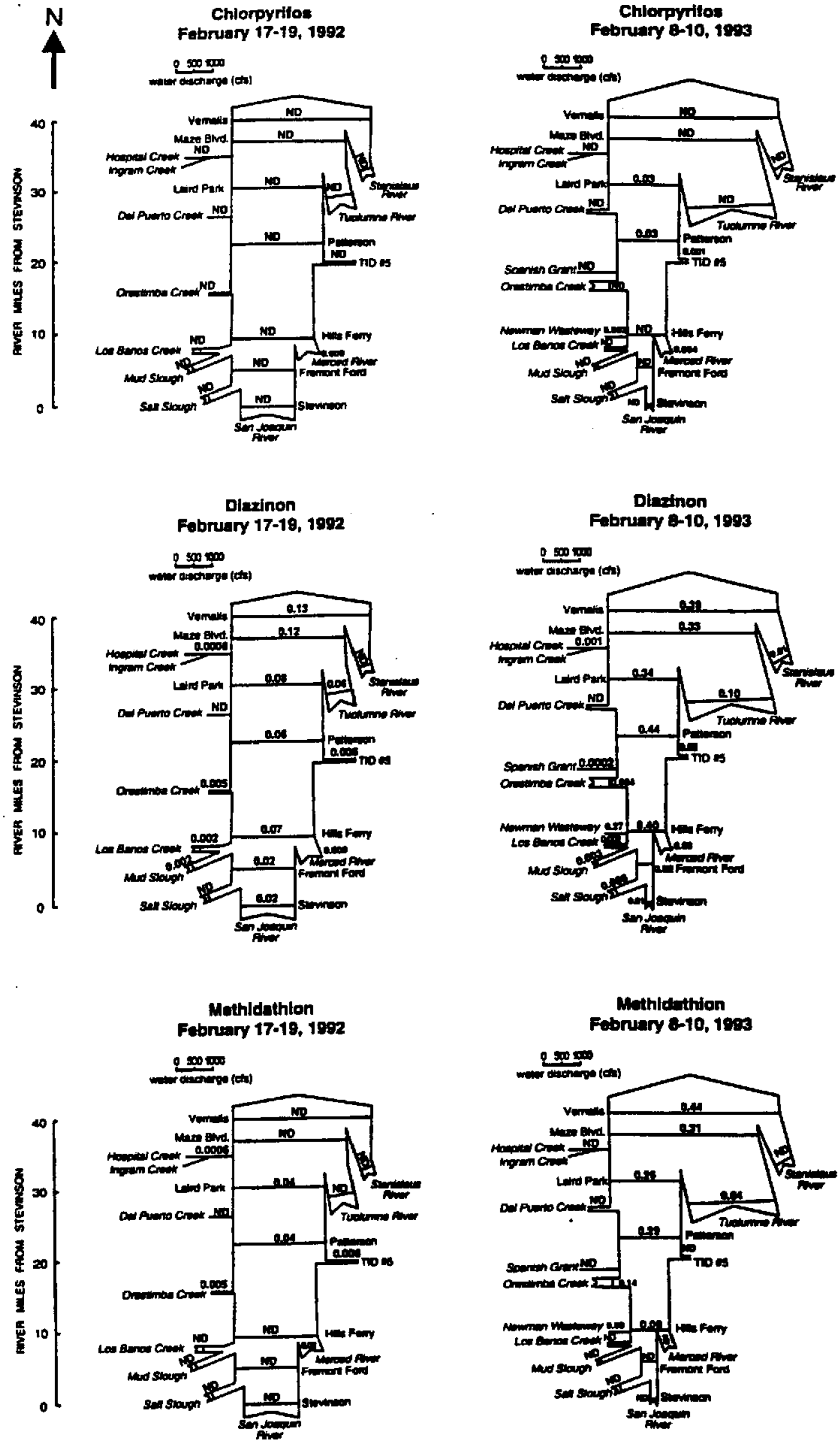

Figure 12. Pesticide loads (lbs/hour) in the San Joaquin River. Water flow is from south to north.

(From Ross et al., 1996)

Lisa Joan Ross
124 Conductor Way
Folsom, CA 95630
(916) 324-4116 (Work)

Education:

Doctor of Philosophy, Ecology, June 1997
University of California, Davis, CA.

Master of Science, Botany, May 1982
Arizona State University, Tempe, AZ.

Bachelor of Arts, Biology, May 1978
State University of New York, Binghamton, NY.

Professional Experience:

Senior Environmental Research Scientist
California Department of Pesticide Regulation
Sacramento, CA 95814

July 1987- to present

Conduct research on the fate, behavior, and mitigation of pesticides in the environment. Direct and review research conducted by junior scientific staff regarding pesticides. Research expertise includes mass balance studies of pesticide dissipation in rice and row crop agro-ecosystems as well as examine the movement and mitigation of pesticides into surface water and air. Utilize uni- and multivariate statistical procedures to analyze data. Coordinate research efforts among scientists from universities, state and federal government agencies, and the private sector. Publish manuscripts and reports and make presentations at scientific and public meetings. Instruct field staff in proper sampling techniques. Interview and hire scientific staff.

July 1984- June 1987

Associate Environmental Hazards Scientist
California Department of Food and Agriculture
Sacramento, CA 95814

Designed and conducted field experiments on the fate of pesticides in the environment using mass balance techniques and volatilization flux methodologies. Organized a quality control program for our chemistry laboratory. Prepared manuscripts and reports, and gave seminars at scientific meetings. Reviewed experimental designs, study plans, and reports of junior scientific staff. Instruct field staff in proper sampling techniques. Interview and hire scientific staff.

Oct. 1983- June 1984	**Special Consultant** California Department of Food and Agriculture Sacramento, CA 95814 Conducted univariate and multivariate data analyses and wrote reports on the environmental fate of pesticides.
Sept. 1982- Oct. 1983	**Post-Graduate Research Assistant** Statewide Air Pollution Research Center Riverside, CA 92521 Designed and implemented research on the effects of acidic mists and fog on plant yield and physiology. Statistically analyzed study results and prepared reports. Hired, supervised, and coordinated schedules of technical support staff.
May 1980- July 1982	**Research Assistant,** Arizona State University Tempe, AZ 85281 Designed and implemented research concerning the effects of air pollutants on lichen community ecology and physiology. Utilized univariate and multivariate statistical analyses. Published manuscripts of lichen eco-physiology.
Aug. 1979- May 1980	**Graduate Teaching Assistant** Arizona State University Tempe, AZ 85281 Taught laboratory classes in general biology and botany. Prepared exams and organized laboratory demonstrations and lectures.
Sept. 1978- July 1979	**Assistant Curator** New York State Museum Herbarium Albany, NY Performed plant identification, collected specimens for acquisition, and organized and prepared specimens for a move to a new herbarium.

PUBLICATIONS

Ross, L.J., B. Johnson, D.K. Kim, and J. Hsu. 1996. Prediction of methyl bromide flux from area sources using the ISCST model. J. Environ. Qual. 25(4): 885-891..

Ross, L.J., B. Johnson, D.K. Kim, and J. Hsu. Prediction of methyl bromide flux from area sources using the ISCST model. 1995. CA. Dept. Pesticide Regulation Report, EH 95-03.

Lee, M.J., L.J. Ross, and R.G. Wang. 1992. Integrating environmental toxicology and monitoring in the development and maintenance of a water quality program: California's rice herbicide scenario. In: R.L. Jolley and R.G. Wang, Eds. Effective and Safe Waste Management: Interfacing Sciences and Engineering with Monitoring and Risk Analysis. Lewis Publishers, Inc., CRC Press, Boca Raton, FL.

Ross, L.J., S. Nicosia, M. McChesney, K.L. Hefner, D. Gonzalez, and J.N. Seiber. 1990. Volatilization, off-site deposition, and dissipation of DCPA in the field. J. Environ. Qual. 19:715-722.

Ross, L.J., S. Powell, J.E. Fleck, and B. Buechler. 1989. Dissipation of bentazon in commercial rice fields. J. Environ. Qual. 18:15-20.

Ross, L.J., S. Nicosia, M. McChesney, K.L. Hefner, D. Gonzalez, and J.N. Seiber. 1989. Volatilization, off-site deposition, dissipation, and leaching of DCPA in the field. CA. Dept. Food & Ag. Report No. 89-2.

Fleck, J.E., L.J. Ross, and K. Hefner. 1988. Endosulfan and chlorthal-dimethyl residues in water and sediment of Monterey County. CA. Dept. Food & Ag. Report No. 88-3.

Gonzalez, D., L.J. Ross, R. Segawa, and B. Fong. 1987. Variation of endosulfan residues in water and sediment of Monterey County. CA. Dept. Food & Ag. Report No. 87-5.

Ross, L.J. and R.J. Sava. 1986. Fate of thiobencarb and molinate in rice fields. J. Environ. Qual. 15:220-225.

Ross, L.J., D.J. Weaver, R.J. Sava, and N. Saini. 1986. Off-target drift of MCPA: "Real-time air sampling". CA. Dept. Food & Ag. Report, Sacramento, CA.

Segawa, R., L.J. Ross, and J. Troiano. 1985. Monitoring selenium, nickel, and chromium concentrations in agricultural commodities of the San Joaquin Valley, California. CA. Dept. Food & Ag. Report, Sacramento, CA.

Ross, L.J., R.J. Sava, and R.J. Oshima. 1984. Environmental fate of selected rice herbicides under field conditions. CA. Dept. Food & Ag. Report, Sacramento, CA.

Ross, L.J. and T.H. Nash III. 1983. The effects of ozone on gross photosynthesis in lichens. Environ. & Exp. Bot. 23:71-77.

Nash III, T.H., T. Moser, S.O Link, L.J. Ross, A.G. Olafson, and U. Matthes. 1982. Lichen photosynthesis in relation to CO_2 concentration. Oecologia 58:52-56.

PRESENTATIONS AT PROFESSIONAL MEETINGS

Ross, L.J. 1996. Use of vegetation to control insecticide runoff in orchards. 212th American Chemical Society Meeting. August 25-29. Orlando, FL.

Ross, L.J. 1996. Best management practices and principles. Western Crop Protection Regulatory Conference. August 20-21. Sacramento, CA.

Ross, L.J. 1994. Mass Loading of pesticides in the San Joaquin River, CA. 207th American Chemical Society Meeting. March 13-17. San Diego, CA.

Ross, L.J., D. Kim, R. Segawa, B. Johnson, and J. Hsu. 1993. Methyl bromide concentrations in air around tarped and untarped field applications. 205th American Chemical Society Meeting. March 28-April 2. Denver, CO.

Ross, L.J. and J. Domagalski. 1992. Spatial and temporal distribution of pesticides in the San Joaquin River, CA. 13th Annual Society for Environmental Toxicology and Chemistry. Nov. 8-12. Cincinnati, OH.

Ross, L.J., J. Hsu, S. Richman, K. Hefner. 1992. Spatial and temporal distribution of pesticides in the San Joaquin River. 203rd American Chemical Society Meeting. April 5-10. San Francisco, CA.

Ross, L.J., S. Nicosia, M. McChesney, K. Hefner, D. Gonzalez, and J.N. Seiber. 1990. Volatilization, off-site deposition, and dissipation of DCPA in the field. 11th Annual Society for Environmental Toxicology and Chemistry. Nov. 11-15. Arlington, VA.

Ross, L.J. and M. Peterson. 1988. Predicting atmospheric distribution of pesticides for use in a regulatory strategy. Third Chemical Congress of North America. June 5-10. Toronto, Canada.

Ross, L.J. and S. Powell. 1988. Dissipation of bentazon under rice field conditions. 22nd Rice Technical Working Group. June 27-29. Davis, CA.

Ross, L.J. and R.J. Sava. 1985. Environmental fate of rice herbicides. Symposium on the fate of pesticides in the environment, sponsored by Univ. CA. Agric. Exp. Station and the National Agric. Chem. Assoc. April. Sacramento, CA.

Ross, L.J. and T.H. Nash III. 1981. Urban impacts on a coastal lichen community. Ecological Soc. Am. August. Durham, NC.

Attachment Two

BRUCE R. JOHNSON

Department of Pesticide Regulation
1020 N St. Rm 161
Sacramento, CA 95814-5624
(916) 324-4106 (FAX: 4088)
johnson@empm.cdpr.ca.gov

2019 Whittier Dr.
Davis, CA 95616
(916) 753-4788

EDUCATION

PhD Ecology. Dec., 1986. University of California, Davis. Emphasis on population biology, plant ecophysiology, systems ecology, and computer modeling and simulation. Dissertation topic: Microsite Influence on Lodgepole Recruitment in Mountain Meadows. GPA 3.7. Dr. John Menke.

M.S. Range Management. June, 1979. University of California, Berkeley. Courses in range inventory and ecology, plant identification, plant physiology, economics, computer modeling and simulation. GPA 3.7. Dr. James Bartolome/Dr. John Menke.

A.B. Mathematics and Statistics. June, 1971. University of California, Berkeley. Comprehensive studies in linear algebra, calculus, logic, probability and statistics. Two year lower division honors math program. Mathematics/statistics tutor for Honor Student Society. Phi Beta Kappa. GPA 3.6.

RECENT COURSES

C Programming: 5 day course Jan 1995

Time Management: 8 hour course Jan 1994

Lead Person Workshop: 24 hour course in supervision, April 1991.

Basic Supervision: 40 hour course in fundamentals of supervision, Feb 1990.

Regulatory Universe: An Overview of Local, State, and Federal Statutes. University Extension short course in Hazardous Substances program. Nov 1987.

RECENT WORK EXPERIENCE

Senior Environmental Research Scientist. Dept. Pesticide Regulation Feb 1989 - present. Participated in committee to recommend guidelines on the use of Monte Carlo simulation techniques for risk assessment. Supervised 5 minority students in database project. Organized work flow for efficiency and to provide quality assurance. Made presentation to statewide committee asssessing risk evaluation within State EPA. Current chair of computer committee to recommend policy for computer use within branch. Programmed and ran computer simulation models for assessing leaching potential and air contamination potential. Developed Specific Numerical Values to satisfy legislative mandate (The Ground Water Contamination Prevention Act). Assessed adequacy of internal procedures for ground water sampling. Reviewed protocols, reports, inter agency studies. Reviewed and assessed DowElanco studies and worked with Air Resources Board personnel in determining feasiblity of Telone reintroduction. Conducted computer simulation studies, analyzed field monitoring results and worked with DPR Enforcement Branch and private industry in assessing continued use of methyl bromide. Provided scientific review, analysis and testimony on bentazon for the Subcommittee of the Pesticide Registration and Evaluation Committee. Helped organize, manage and participate in two special workgroup projects: whitefly model development and ground water vulnerability.

Associate Environmental Research Scientist. Dept. Pesticide Regulation June 1988-Jan 1989. Supervised student work, created ground water detection history database. Worked with Registration and Information Services personnel to maintain and improve physicochemical database. Wrote feasibility study to acquire computer equipment. Evaluated chemical study information and developed Specific Numerical Values. Assisted computer personnel in hardware and software maintenance and trouble shooting with computer users.

ACADEMIC WORK EXPERIENCE

Post Graduate Researcher. U. C. Davis. Jan. 1988- May 1988 (half time). Responsible for design, development and implementation of wheat phenology model/management information system. Assisted in development of imaging software for MICRONEYE digital imaging equipment. Dr. Shu Geng. Agronomy Department.

Post Graduate Researcher. U. C. Davis. Jan. 1986-Dec. 1987. Designed, managed and budgeted for field research toward understanding population biology of barnyardgrass including competition, reproductive output, phenology and seed ecology. Wrote and documented user friendly computer simulation model of population biology of barnyardgrass which incorporated results from field research. Developed reference data base. Dr. Robert F. Norris. Botany Department.

Research Assistant. U.C. Davis. 1981-1986. Received competitively awarded departmental research stipend. Designed and implemented field studies to elucidate factors influencing lodgepole pine recruitment in meadows. Transplanted lodgepole seedlings into mountain meadows to test impact of water table, competition, drought stress, light reduction, and small mammals on seedling establishment. Experimental work to assess seed predation dynamics. Involved extensive FORTRAN programming for data analysis, data base management, graphics plotting, experimental planning and testing robustness of F distribution. Dr. John Menke, Department of Agronomy and Range Science.

Postgraduate Research Fellow. U.C. Davis. 1979-81. Programmed on PDP11/34 and Burroughs 6800. Maintained, implemented and used statistical programs: Minitab, BMDP, VJT, SAS, Ridge Regression, ANOVA, Path Analysis, Principle Components Analysis, CSMP. Wrote user oriented utilities and provided documentation. Helped write data base manager. Consulted with departmental personnel for statistical design and computer use. Dr. Bill Williams, Department of Agronomy and Range Science.

OTHER EXPERIENCE

Computer Manager and Consultant. Agronomy and Range Science Department, U.C. Davis. Jan. 1988 to May 1988. Provided support for departmental mini- and micro-computers including programming, software and hardware maintenance, statistical consulting, software installation, purchasing. Supported MS-DOS on IBM compatible AT level micro-computers and RSX 11M+ operating system on a PDP11/73. Consulting for Word Perfect, Word, Display Write 4, printer interfacing for HP Laser Series II, Toshiba, Spinwriter, BMDP and Minitab statistical programs, FORTRAN, HI-SCREEN XL, Kermit, Sigmaplot, and other software. Dr. Bill Williams, Agronomy Department.

Research Associate. Institute for Local Self Government, Berkeley. 1974-79. Initiated local government studies on fire protection costs, workers compensation, and self-funded insurance programs: research design, variable selection and definition, statistical analysis and forecasting, data collection, travel, write-up and editing, lecture-demonstration of results. Mr. Jeff Smeyser.

Actuarial Assistant. Blue Shield of California, San Francisco. 1971-73. Designed medical cost studies, maintained and improved ongoing statistical reports, instructed EDP personnel. Mr. Louis Trillo.

PUBLICATIONS

Johnson, Bruce, Carol Johnson and James Seiber. 1994. The use of regression equations for quality control in a pesticide physical property database. Environmental Management 19(1):127-134.

Johnson, Bruce R., J. T. Leffingwell, and M. Rose Wilkerson. 1994. Assessing leaching potential in California under the Pesticide Contamination Prevention Act. p. 155-163 IN Richard C. Honeycutt and Daniel J. Schabacker (eds.) Mechanisms of pesticide movement into ground water. Lewis Publishers, Boca Raton.

Johnson, Bruce R. 1991. A simple adsorption/dilution model for rice herbicides. Bulletin of Environmental Contamination and Toxicology 47:244-250.

Johnson, Bruce. 1988. Setting revised specific numerical values November 1988. Environmental Hazards Assessment Program. Department of Food and Agriculture, State of California. Sacramento, CA. EH 88-12.

Johnson, Bruce. 1989. Setting revised specific numerical values October 1989. Environmental Hazards Assessment Program. Department of Food and Agriculture, State of California. Sacramento, CA. EH 89-13

Johnson, Bruce. 1991. Setting revised specific numerical values. State of California, Department of Food and Agriculture, Division of Pest Management, Environmental Protection and Worker Safety, Environmental Monitoring and Pest Management Branch. EH91-6.

Johnson, Bruce R., Chris Collison, S.J. Marade and Nancy Miller. 1992. A test of procedures for determining the ground water protection list. Environmental Hazards Assessment Program. EH 92-06.

Ross, L.J., B. Johnson, K.D. Kim, and J. Hsu. 1995. Prediction of methyl bromide flux from area sources using the ISCST model EH 95-03 February 1995.

Ross, L.J., B. Johnson, K.D. Kim, and J. Hsu. 1996. Prediction of methyl bromide flux from area sources using the ISCST model. Journal of Environmental Quality 25(4):885-891.

Troiano, John, Bruce Johnson, Sally Powell, and Steve 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 Hazards Assessment Program. State of California Environmental Protection Agency, Department of Pesticide Regulation. EH92-09.

Troiano, John, Bruce Johnson, Sally Powell and Steve Schoenig. 1994. Use of cluster and principal component analyses to profile areas in California where ground water has been contaminated by pesticides. Environmental Monitoring and Assessment 32:269-288.

Wilhoit, Larry, Steve Schoenig, David Supkoff, and Bruce Johnson. 1994. A regional simulation model for silverleaf whitefly in the Imperial Valley. Pest Management Analysis and Planning Program, Department of Pesticide Regulation, Environmental Protection Agency, State of California. PM 94-01.

ACADEMIC REPORTS

Johnson, Bruce R. and Robert F. Norris. 1988. Development of a weed population dynamics model for barnyardgrass and other weeds. Final Report UC IPM Project. University of California, Davis, California.

Johnson, Bruce R. and Robert F. Norris. 1988. Users manual for POPDYM 3.3.2. UC IPM Project. University of California, Davis, California.

Johnson, Bruce R. and Robert F. Norris. 1988. Technical manual for POPDYM 3.3.2. Part A: Program structure. UC IPM Project. University of California, Davis, California.

Johnson, Bruce R. and Robert F. Norris. 1988. Technical manual for POPDYM 3.3.2. Part B: The biological equations. UC IPM Project. University of California, Davis, California.

Johnson, Bruce R. and Robert F. Norris. 1988. Technical manual for POPDYM 3.3.2. Part C: Source code listing. UC IPM Project. University of California, Davis, California.

OTHER INTERESTS
Swimming, bicycling, California Environmental Quality Act (CEQA), Public Records Act

REFERENCES
Available upon request.

Brian J. Finlayson
Department of Fish and Game
Pesticide Investigations Unit
1701 Nimbus Road, Suite F
Rancho Cordova, CA 95670
(916) 358-2950
FAX (916) 358-2953

Attachment Three

College Education: 1974,B.S. Fisheries (Chemistry Minor), Humboldt State University, Arcata, CA; 1977 M.S. Fisheries (Water Quality Emphasis), Humboldt State University, Arcata, CA; Title of Master's Thesis: *Mercury contaminated aquatic biota associated with geothermal and cinnabar deposits in Sonoma County, California.*

Membership in Professional Organizations: American Fisheries Society (1972); Xi Sigma Pi (1973); American Society for Testing and Materials (1984); Society of Environmental Toxicology and Chemistry (1981).

Professional Employment: Chief of Pesticide Investigations Unit. I supervise and manage a field and laboratory program which establishes policy and procedures for assessing the impacts of pesticides on fish, plant, and wildlife resources. The activities of the Pesticides Investigations Unit can be divided into the following five general categories: (1) Investigation of fish and wildlife incidents involving pesticides; (2) Assessment of the hazards of pesticides to fish, plant, and wildlife resources; (3) Protection of threatened and endangered species; (4) Assessment and environmental analysis of pest control and eradication programs on fish, plant, and wildlife resources; and (5) Coordination and approval of Department pesticide uses and training of Department personnel using pesticides.

Publications (last four years): (1) Finlayson, B., M. Menconi, and R. Hosea. 1996. Monitoring fish and wildlife incidents involving pesticides in California. *Environ. Toxicol. Chem.* (in press); (2) Finlayson, B., J. Harrington, R. Fujimura, and G. Isaac. 1993. Identification of methyl parathion toxicity in the Colusa Basin Drain Water. *Environ. Toxicol. Chem.* 12:291-304; (3) Brandt, O., R. Fujimura, and B. Finlayson. 1993. The use of *Neomysis mercedis* (Crustacea:Mysidacea) for estuarine toxicity tests. *Trans. Am. Fish. Soc.* 122:279-288; and(4) Heath, A., J. Cech, J. Zinkl, B. Finlayson, R. Fujimura. 1993. Sublethal effects of methyl parathion, carbofuran, and molinate on larval striped bass. *Am. Fish. Soc. Symp.*

Service and Goals as a Fisheries Scientist: I am a Certified Fisheries Scientist (Number 1792). I am the current Chairman of the Fish Management Chemicals Subcommittee of the Task Force on Fishery Chemicals.

STATE OF CALIFORNIA

Attachment Four

NONDISCRIMINATION COMPLIANCE STATEMENT

STD. 19 (REV. 2-93)

COMPANY NAME

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, physical disability (including HIV and AIDS), mental disability, medical condition (cancer), age (over 40), marital status, and denial of family care leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME
Paul H. Gosselin

DATE EXECUTED
7/25/97

EXECUTED IN THE COUNTY OF
Sacramento

PROSPECTIVE CONTRACTOR'S SIGNATURE
Paul H. Gosselin

PROSPECTIVE CONTRACTOR'S TITLE
Assistant Director, Division of Enforcement, Environmental Monitoring and Data Management

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME
Dept. of Pesticide Regulation