Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

Project Information

1. **Proposal Title:**

   Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

2. **Proposal applicants:**

   Nathan Dechoretz, California Department of Food and Agriculture
   Steve Schoenig, Calif. Dept. of Food and Agriculture
   Carri Benefield, Calif. Dept. of Food and Agriculture

3. **Corresponding Contact Person:**

   Nathan Dechoretz
   Calif. Dept. of Food and Agriculture
   Integrated Pest Control Branch 1220 N Street, Room A-357 Sacramento, CA 95814
   916 654-0768
   ndechoretz@cdfa.ca.gov

4. **Project Keywords:**

   Aquatic Plants
   Natural Resource Management
   Nonnative Invasive Species

5. **Type of project:**

   Implementation_Full

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Non-Native Invasive Species

8. **Type of applicant:**

   State Agency

9. **Location - GIS coordinates:**

Latitude:

Longitude:

Datum:

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

The proposed project cross many ecozones--- stretches from the heart of the Delta (Sacramento, San Joaquin, and Stanislaus Counties) to as far north as Shasta County and as far south as Fresno County. Major waterways impacted: Fall River, Sacramento River, Feather River, Bear River, Cache Creek, San Joaquin River, Calaveras River, Tuolumne River, Old River, Middle River, and Kings River.

10. **Location - Ecozone:**

    3.3 Chico Landing to Colusa, 3.4 Colusa to Verona, 3.5 Verona to Sacramento, 6.4 Colusa Basin, 7.7 Butte Sink, 8.1 Feather River, 8.3 Bear River and Honcut Creek, 8.4 Sutter Bypass, 10.1 Cache Creek, 12.2 Merced River to Mendota Pool, 12.3 Mendota Pool to Gravelly Ford, 13.2 Tuolumne River, 1.1 North Delta, 1.2 East Delta, 1.3 South Delta, 1.4 Central and West Delta, 11.3 Calaveras River, Code 15: Landscape, Code 16: Inside ERP Geographic Scope, but outside ERP Ecozones

11. **Location - County:**

    Butte, Fresno, Nevada, Placer, Sacramento, San Joaquin, Shasta, Sonoma, Stanislaus, Sutter, Yolo, Yuba

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    2, 3, 4, 5, 6, 11, 18, 20

15. **Location:**

    California State Senate District Number: 1, 3, 4, 5, 6, 12, 14

    California Assembly District Number: 2, 3, 4, 5, 7, 8, 10, 11, 15, 17, 26, 32

16. **How many years of funding are you requesting?**

17. **Requested Funds:**

a) Are your overhead rates different depending on whether funds are state or federal?

No

If no, list single overhead rate and total requested funds:

Single Overhead Rate: 21.19

Total Requested Funds: $457,162.00

b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

Yes

If yes, identify project number(s), title(s) and CALFED program.

99-F08	**Purple Loosestrife Prevention, Detection, and Control Actions for the Sacramento-San Joaquin Delta and Associated Hydrological Units**	**ERP**
99-N11	**Purple Loosestrife Prevention, Detection, and Control Actions for the Sacramento-San Joaquin Delta System and Associated Hydrological Units**	**ERP**

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

    No

    Have you previously received funding from CVPIA for other projects not listed above?

    No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

    No

    Please list suggested reviewers for your proposal. (optional)

    Kim Webb U.S. Fish and Wildlife Services 209-946-6400 kwebb@delta.dfg.gov

21. **Comments:**

    Kim Webb is very familar with our purple loosestrife project efforts and invasive species issues concerning the Delta.

Environmental Compliance Checklist

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      The California Department of Food and Agriculture is charged with Noxious Weed detection and eradication for rated pests. Purple loosestrife is a B-rated weed by the California Department of Food and Agriculture. All currently proposed methods of purple loosestrife management are either inherently benign or have passed through CEQA equivalent environmental reviews. The herbicide Rodeo has been registered in California for over a decade and has passed review by both the US EPA and the California EPA for label compliant usage on aquatic vegetation. CDFA will follow all use restriction requirements recommended by CalEPA in their approval of the material use. The CDFA will consult with the California Department of Fish and Game and the United States Fish and Wildlife Service to determine if additional measures are needed for site specific actions in sensitive habitats (e.g., habitats of threatened and endangered species identified in the Natural Diversity Database). Where deemed necessary permits will be obtained and water sampling will be conducted by the Pesticide Investigation Unit of the California Department of Fish and Game. Recent water sampling after the use of Rodeo for purple loosestrife and Giant Cane removal showed concentrations in nearby water far lower than known toxicity to fish and amphibians. The use of biological control agents for purple loosestrife (Galerucella calmariensis , G. pusilla, Hylobius transversovittatus, and Nanophytes marmoratus) have been approved nationally for release by the Technical Advisory Group (TAG) of US Department of Agriculture based on host specificity, after extensive feeding trials on appropriate native and horticultural plants. They have been approved for release in California after testing and review by California Department of Food and Agriculture scientists and regulators. Project leaders do not foresee any implementation issues/constraints.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR

Xnone

NEPA
-Categorical Exclusion
-Environmental Assessment/FONSI
-EIS
Xnone

If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      Not Applicable

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

   LOCAL PERMITS AND APPROVALS

   Conditional use permit

   Variance

   Subdivision Map Act

   Grading Permit

   General Plan Amendment

   Specific Plan Approval

   Rezone

   Williamson Act Contract Cancellation

   Other

   STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

none at this time.

Land Use Checklist

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   Yes

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   A specific non-native invasive species, purple loosestrife will be taken out of the system. Overall land use will not be changed--- the habitat will be improved while not impacting overall land use.

4. **Comments.**

   none at this time.

Conflict of Interest Checklist

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Nathan Dechoretz, California Department of Food and Agriculture
Steve Schoenig, Calif. Dept. of Food and Agriculture
Carri Benefield, Calif. Dept. of Food and Agriculture

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

California Department of Fish and Game	Pesticide Investigations Unit
None	None
None	None
None	None
None	None

Helped with proposal development:

Are there persons who helped with proposal development?

No

Comments:

none at this time.

Budget Summary

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Expanded Education Outreach	170	4070.30	1178.69	500.00	200.00	0.00	0.00	0.00	5948.99	1260.59	7209.58
2	Ongoing Training of Professionals	130	3313.30	985.57	300.00	200.00	0.00	0.00	0.00	4798.87	1016.88	5815.75
3	Continued Delta wide loosestrife survey	720	11197.00	2432.23	0.00	500.00	0.00	5000.00	1500.00	20629.23	4371.33	25000.56
4	Continued contiguous basin survey	720	11197.00	2432.23	4500.00	500.00	0.00	0.00	1500.00	20129.23	4265.38	24394.61
5	Update GIS System and Maps	380	5080.60	910.13	0.00	500.00	0.00	0.00	0.00	6490.73	1375.39	7866.12
6	Update Adaptive Managment plans	116	2970.28	879.23	200.00	0.00	0.00	0.00	0.00	4049.51	858.09	4907.60
7	Environmental consultation and planning	160	4994.40	1548.26	0.00	0.00	0.00	0.00	0.00	6542.66	1386.39	7929.05
8	Continued/expanded implementation of controls	1280	18672.00	3793.75	4500.00	5000.00	0.00	8000.00	0.00	39965.75	8468.74	48434.49
9	Continued Monitoring of control success	220	4828.60	1330.65	0.00	500.00	0.00	1000.00	0.00	7659.25	1623.00	9282.25
10	Continued Monitoring of water quality	140	3314.60	944.42	0.00	0.00	20000.00	0.00	1200.00	25459.02	5394.77	30853.79
		4036	69638.08	16435.16	10000.00	7400.00	20000.00	14000.00	4200.00	141673.24	30020.56	171693.80

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Expanded Education Outreach	170	4070.30	1178.69	500.00	200.00	0.00	0.00	0.00	5948.99	1260.59	7209.58
2	Ongoing Training of Professionals	130	3313.30	985.57	300.00	200.00	0.00	0.00	0.00	4798.87	1016.88	5815.75
3	Continued Delta wide loosestrife survey	575	8930.00	1937.23	0.00	500.00	0.00	0.00	1500.00	12867.23	2726.57	15593.80
4	Continued contiguous basin survey	575	8930.00	1937.23	4500.00	500.00	0.00	0.00	1500.00	17367.23	3680.12	21047.35
5	Update GIS System and Maps	280	4055.60	800.15	0.00	500.00	0.00	0.00	0.00	5355.75	1134.88	6490.63
6	Update Adaptive Managment plans	116	2970.28	879.23	200.00	0.00	0.00	0.00	0.00	4049.51	858.09	4907.60
7	Environmental consultation and planning	160	4994.40	1548.26	0.00	0.00	0.00	0.00	0.00	6542.66	1386.39	7929.05
8	Continued/expanded implementation of controls	1280	18672.00	3793.75	4500.00	5000.00	0.00	0.00	0.00	31965.75	6773.54	38739.29
9	Continued Monitoring of control success	220	4828.60	1330.65	0.00	500.00	0.00	0.00	0.00	6659.25	1411.10	8070.35
10	Continued Monitoring of water quality	140	3314.60	944.42	0.00	0.00	20000.00	0.00	1200.00	25459.02	5394.77	30853.79
		3646	64079.08	15335.18	10000.00	7400.00	20000.00	0.00	4200.00	121014.26	25642.93	146657.19

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Expanded Education Outreach	170	4070.30	1178.69	500.00	200.00	0.00	0.00	0.00	5948.99	1260.59	7209.58
2	Ongoing Training of Professionals	130	3313.30	985.57	300.00	200.00	0.00	0.00	0.00	4798.87	1016.88	5815.75
3	Continued Delta wide loosestrife survey	470	6899.50	1411.66	0.00	500.00	0.00	0.00	1500.00	10311.16	2184.93	12496.09
4	Continued contiguous basin survey	470	6899.50	1411.66	4500.00	500.00	0.00	0.00	1500.00	14811.16	3138.48	17949.64
5	Update GIS System and Maps	160	2825.60	668.17	0.00	500.00	0.00	0.00	0.00	3993.77	846.28	4840.05
6	Update Adaptive Managment plans	116	2970.28	879.23	200.00	0.00	0.00	0.00	0.00	4049.51	858.09	4907.60
7	Environmental consultation and planning	160	4994.40	1548.26	0.00	0.00	0.00	0.00	0.00	6542.66	1386.39	7929.05
8	Continued/expanded implementation of controls	1280	18672.00	3793.75	4500.00	5000.00	0.00	0.00	0.00	31965.75	6773.54	38739.29
9	Continued Monitoring of control success	220	4828.60	1330.65	0.00	500.00	0.00	0.00	0.00	6659.25	1411.10	8070.35
10	Continued Monitoring of water quality	140	3314.60	944.42	0.00	0.00	20000.00	0.00	1200.00	25459.02	5394.77	30853.79
		3316	58788.08	14152.06	10000.00	7400.00	20000.00	0.00	4200.00	114540.14	24271.05	138811.19

Grand Total=457162.18

Comments.

Budget Justification

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

Direct Labor Hours. Provide estimated hours proposed for each individual.

There will be a consistent pattern to the staffing on the project. A Senior Environmental Research Scientist will provide formal management and oversight, Labor hours: 176hrs/year of project. An Associate Agricultural Biologist will be a lead person for the field crews, multi-agency coordination, treatment coordination and perform the education activities, Labor hours: 1380hrs/year of the project. The field crew will consist of three Scientific Aids working 3-4 months full time during the summer, Labor hours: 827hrs/aid/year of the project; Total Labor for 3-person crew = 2480 hrs/year of the project.

Salary. Provide estimated rate of compensation proposed for each individual.

Senior Environmental Research Scientist, $34.83/hr An Associate Agricultural Biologist, $27.60/hr Field crew of three Scientific Aids $10.25/hr per person

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

Senior Environmental Research Scientist @ 31% benefits An Associate Agricultural Biologist @ 31% benefits Field crew of three Scientific Aids @ 10.73% benefits

Travel. Provide purpose and estimate costs for all non-local travel.

Some infestations are located beyond a day's commute and therefore require overnight travel. Travel costs are typically $100/day per person ($60 accommodation at State rate + $40 per diem). Travel costs based on 3 crew members and a Manager (Associate) traveling throughout the field season, as well as a manager (Associate) to give training and educational outreach talks.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Expenses will include: safety supplies/gear (gloves, goggles, soap, towels, labels, first aid, etc.), monitoring supplies (tapes, film, stakes, etc.), replacement control equipment (shovels, shears, hand-cans, backpack sprayers, bags, etc.), waders and other miscellaneous gear/expendables; chemical (Rodeo) costs ($70/gallon of product) and surfactant ($30/gallon).

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

The California Dept. of Fish and Game Pesticide Investigations Unit will be contracted out to conduct water sampling and analysis. Sampling at 3 sites, on 3 dates for Rodeo and surfactant, in addition to toxicity tests will cost an estimated $20,000/year.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

$5,000.00 for a Trimble GPS unit and software. Unit and accessaries: $4.200.00; software: $800. $8,000.00 for truck mounted sprayer necessary to treat several remote, non-boat access sites. $5000.00 sprayer; $2000 mounting system and installation into truck; $500 hose; $500 nozzles and attachemnts

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

Project management is conducted by both Associate and Senior Scientists. Costs are associated per task, particularly in hours shown for Tasks 6 and 7.

Other Direct Costs. Provide any other direct costs not already covered.

Other direct costs include: boat and vehicle maintenance, services, milage, and repair.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Indirect costs include all of the above mentioned, all cost needed in operating a state program, general office requirements, administration, contracting, etc. Note: The Department submits a proposal/memo each year to determine what overhead needs are--- a set rate is determined/set each year for all agencies. All forms can be filled out as requested.

Executive Summary

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

Purple loosestrife is an aggressive, non-native plant that has invaded North America. In California purple loosestrife currently exists in mostly small, but growing infestations. It poses an escalating threat to almost all wetland and riparian habitats in California. To specifically address the spread of this aggressive wetland invader, the California Department of Food and Agriculture (CDFA) submitted a 3-year proposal in 1999. A grant was awarded. CDFA is entering its last year of funding. Expansion and Continuation of a prevention, detection, and control: To date, we have met and exceeded all project goals. As a result of this project, five additional populations in the heart of the Delta have been located (SEE enclosed Delta Maps). Expanded and new infestations were also found in the outer reaches of the CALFED watershed. To date, treatment results are looking promising. With additional years of treatment purple loosestrife can be significantly reduced if not entirely eradicated. With additional funding, purple loosestrife can be prevented from taking over California's waterways as seen in the northeastern U.S. A Hypothesis: The following project presents a general hypothesis, that loosestrife is present in multiple locations in the Delta system and that it can be locally eradicated, controlled, and contained by implementing regional adaptive management plans. With additional time and resources, the CDFA will carry out a series of tasks that will result in: Objectives of this expanded prevention, detection and control project are THREE fold: 1)A continued exhaustive yearly survey and mapping of the Sacramento-San Joaquin Delta. 2)Continued and expanded local eradication, control, and containment of loosestrife in the Delta and other hydrological units. 3)An expanded education outreach and training campaign of the boating, fishing, water fowl hunting, watershed groups, and similar public citizenry. Relationship to CALFED ERP Goals: Restoration priorities for the Multi-Regional Bay-Delta Areas [MR-PRIORITY #1] Sacramento Region [SR-PRIORITY #5] San Joaquin Region [SJ-PRIORITY #4] Delta Region [DR-PRIORITY #5] Bay Region [BR-PRIORITY #3]

Proposal

California Department of Food and Agriculture

Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed

Nathan Dechoretz, California Department of Food and Agriculture
Steve Schoenig, Calif. Dept. of Food and Agriculture
Carri Benefield, Calif. Dept. of Food and Agriculture

Executive Summary

Purple loosestrife is an aggressive, non-native plant that has invaded North America. In California purple loosestrife currently exists in mostly small, but growing infestations. It poses an escalating threat to almost all wetland and riparian habitats in California.

To specifically address the spread of this aggressive wetland invader, the California Department of Food and Agriculture (CDFA) submitted a 3-year proposal in 1999. A grant was awarded. CDFA is entering its last year of funding.

Expansion and Continuation of a prevention, detection, and control

To date, we have met and exceeded all project goals. As a result of this project, five additional populations in the heart of the Delta have been located (SEE enclosed Delta Maps). Expanded and new infestations were also found in the outer reaches of the CALFED watershed. To date, treatment results are looking promising. With additional years of treatment purple loosestrife can be significantly reduced if not entirely eradicated. With additional funding, purple loosestrife can be prevented from taking over California's waterways as seen in the northeastern U.S.

A Hypothesis

The following project presents a general hypothesis, that loosestrife is present in multiple locations in the Delta system and that it can be locally eradicated, controlled, and contained by implementing regional adaptive management plans. With additional time and resources, the CDFA will carry out a series of tasks that will result in:

Objectives of this expanded prevention, detection and control project are THREE fold:

1) A continued exhaustive yearly survey and mapping of the Sacramento-San Joaquin Delta.
2) Continued and expanded local eradication, control, and containment of loosestrife in the Delta and other hydrological units.
3) An expanded education outreach and training campaign of the boating, fishing, water fowl hunting, watershed groups, and similar public citizenry.

Relationship to CALFED ERP Goals:

Restoration priorities for the Multi-Regional Bay-Delta Areas [MR-PRIORITY #1]
Sacramento Region [SR-PRIORITY #5]
San Joaquin Region [SJ-PRIORITY #4]
Delta Region [DR-PRIORITY #5]
Bay Region [BR-PRIORITY #3]

A. Project Description: Project Goals and Scope of Work

1. Problem:

Purple loosestrife is an aggressive, non-native plant from the European Continent that has invaded North America. This non-native plant was first introduced through contaminated ship ballast water in the 1800s. It has since made its way westward causing immense ecological destruction to wetlands from New York to Washington State. Purple loosestrife was recently included on the Global Invasive Species Program's list of "100 of the World's Worst Invasive Alien Species." However, in California purple loosestrife currently exists in mostly small, but growing infestations. It poses an escalating threat to almost all wetland and riparian habitats in California. This threat is of greatest concern in the Sacramento-San Joaquin Delta where there are a number of threatened and declining species due to a multitude of environmental stressors.

To specifically address the spread of this aggressive wetland invader, the California Department of Food and Agriculture submitted 3-year proposals in 1999 to both a CALFED Directed Action Solicitation and a General Solicitation. Both grants were awarded in 1999 and we are now entering our last year of funding. Through a highly collaborative effort with many state (Calif. Dept. of Fish and Game, Calif. Dept. of Boating and Waterways, Calif. Dept. of Water Resources, Calif. State Parks) and federal (U.S. Fish and Wildlife Services, U.S. Dept. of Agriculture, U.S. Bureau of Reclamation) agency partners, as well as cooperation of local watershed and weed management area groups, **accomplishments over the past two years have included:**

YEAR 1 ACCOMPLISHMENTS:

- A far-reaching education outreach campaign: development and distribution of a brochure, launching and updating of a website, and presentations/training to over 60 groups.
- A comprehensive survey and mapping effort in Shasta, Butte, Sutter, Yuba, Nevada, Placer, Sacramento, San Joaquin, Stanislaus, Fresno, and Yolo Counties (SEE enclosed Bay-Detla Watershed MAP, Map 1).

YEAR 2 ACCOMPLISHMENTS:

- Development of Regional Adaptive Management Plans through collaborative meetings.
- Initiation of a treatment program: control, containment, and eradication.
- Initiation of a monitoring program: treatment success and water quality assurance.

Implementation, Full Scale: ***Expansion and continuation of purple loosestrife prevention, detection, and control***

To date, we have met and exceeded all project goals. At the start of project, White Slough was the only known purple loosestrife infestation in the heart of the Delta (Sacramento/San Joaquin/Stanislaus Counties). As a result of this project, five additional populations have been located in the heart of the Delta (SEE enclosed Delta Maps 2, 3, 4, and 5). An extensive infestation was found infesting the Tuolumne River ---this infestation is a direct seed source threatening further expansion in the south delta. Expanded and new infestations were also found in associated Hydrological Units within the entire CALFED Bay-Delta watershed (Shasta, Butte, Sutter, Yuba, Nevada, Placer, Fresno, and Yolo Counties). Maps were too many and of large sizes (several poster size) to include here--- all maps were provided to CALFED grant managers and will hopefully be made available if deemed necessary to fully assess this proposal.

An Expansion of Project Goals:

While treatment just got underway this summer, treatments results are looking promising. Most infestations are small and scattered and therefore can be locally eradicated. With additional years of treatment purple

loosestrife can be significantly reduced if not entirely eradicated. It is anticipated that infestations in White slough, Ryer Island, Old, Middle, Calaveras, and San Joaquin Rivers can be completely eradicated within three years. The Tuolumne River infestation serves as the biggest challenge and will require the most resources to eradicate. Treatments this summer have significantly reduced plant numbers/densities and with additional years of treatment, will continue to shrink populations and exhaust the seed bank.

It would be a shame to loose ground on control, containment, and local eradication successes accomplished to date. With additional funding, purple loosestrife can be prevented from taking over California's waterways as seen in the purple plagued northeastern United States.

A Hypothesis

The following project presents a general hypothesis, that purple loosestrife is present in multiple locations in the Sacramento-San Joaquin Delta system, and furthermore, that it can be locally eradicated, controlled, and contained by implementing an adaptive management program which addresses each infestation with the most appropriate management technique, as determined by CDFA personnel with outside collaborators. With additional time and resources, the Integrated Pest Control Branch of the California Department of Food and Agriculture will carry out a series of tasks that will result in:

Expanded Prevention, Detection and Control OBJECTIVES THREE FOLD:

1) **A continued exhaustive yearly survey and mapping of the Sacramento-San Joaquin Delta.** A comprehensive annual survey and mapping of the Sacramento-San Joaquin Delta and associated hydrological units will be continued. It is important to note that while surveying for purple loosestrife, CDFA staff is also on the look-out for any new non-native species, plants and invertebrates. Early detection and prevention of new pests, single individuals or small patches, is the most environmentally and economically sound approach in battling invasive species.

2) **Continued and expanded local eradication, control, and containment of loosestrife in the Core Delta and associated CALFED Bay-Delta hydrological units.** Based on regional adaptive management plans, management techniques will continue to be implemented and expanded into newly infested areas. An integrated pest management approach is utilized. Where applicable, hand-removal-by digging with shovels takes place early in the season (May-July) as to not spread seed. Where appropriate, spot treatment with Rodeo takes place throughout the growing season (pre-bloom through senescence). In Shasta and Butte Counties, biological control agents are released in the early spring so that several generations may result from egg laying adults.

3) **An expanded education outreach and training campaign** of the boating, fishing, water fowl hunting, watershed groups and similar public citizenry. Training of agency personnel and public departments (Irrigation Districts, Mosquito Abatement Districts, and Public Works crews), working in and near the Delta, to recognize purple loosestrife and other aquatic nonnative invasive species will also be continued. The key to early detection and prevention is getting as many eyes out there looking for the pest. Last year, three new infestations were found in the Delta as a direct result of education outreach and training.

EDUCATION OUTREACH WORKS, three documented examples:

(1) After attending a training session at their headquarters in Sacramento, Boating and Waterways crews recognized and reported purple loosestrife along the Tuolumne River.

(2) After receiving an educational packet on purple loosestrife (a packet was sent out to many Fish and Game District Botanists), a Fish and Game Biologist conducting raptor surveys along the coast reported purple loosestrife in a section of the Russian River.

(3) Upon leaving a purple loosestrife packet at a San Joaquin Public Works Maintenance Supervisors office, a purple loosestrife brochure was pinned to the lunch-room bulletin board resulting in a new population near

Linden being reported. In fact, the San Joaquin Public Works crews have turned into real Weed Warriors---keeping their eyes peeled for any new aquatics in their service region.

2. Justification:

Need for project; Why critical to the Bay-Delta

The ecological integrity of the Bay-Delta system is threatened by the looming invasion of purple loosestrife. Purple loosestrife is listed by the California Department of Food and Agriculture as a "B" rated noxious weed and as a "species with potential to spread explosively" by the California Exotic Pest Plant Council. Purple loosestrife, which spreads primarily by copious production of seed the size of ground-pepper, becomes established and form dense stands that crowd out native wetland vegetation and associated wildlife, thus threatening the overall biodiversity of aquatic, wetland, and riparian areas.

Ecological/Biological Objectives

The displacement of valued ***flora and fauna*** and the diminishment of critical fish and wildlife habitats has been well documented throughout the United States. In many States, loosestrife makes up more than 50% of the biomass of emergent vegetation causing canopy closure that results in a virtual biological "desert" underneath. Research has shown that common emergent aquatics such as cattails (*Typha* spp.), sedges (*Carex* spp.), and smartweed (*Polygonum* spp.), and floating plants such as *Potamogeton spp.,* and *Lemna minor* cannot successfully compete with loosestrife (Thompson et al. 1987; Weihe and Neely 1997; Fernberg 1998). A literature review also reveals that dramatic changes in the physical as well as the trophic structure of wetland habitat has threatened the following wildlife species: Muskrat, mink, Canada goose, fox, wood duck, mallard, black tern, canvasback, and sandhill (Coddington and Field 1978; Malecki et al. 1993; Skinner et al. 1994). Complex food webs that are maintained by a diversity of native wetland plants and aquatic habitats become simplified or excluded. Animals that rely on the native vegetation for food, shelter, breeding and nesting areas cannot use these heavily infested areas (Skinner et al. 1994; Thompson et al. 1987).

Fish species will also be affected. The rapid decay rate of purple loosestrife leaves has been shown to supply detritus to the ecosystem in Autumn, whereas a much slower decay rate of resident vegetation supplies detritus throughout the winter and early spring (Grout et al. 1997). Consumer organisms important in juvenile Salmon food webs appear to be adapted to take advantage of the detritus provided in these later seasons. In addition, submersed terrestrial vegetation that provides habitat for spawning and zooplankton critical to early survival, will be crowded-out by the establishment of loosestrife (Skinner et al. 1994).

Loosestrife has also jeopardized various ***threatened and endangered*** native wetland plants and wildlife such as a local bulrush (*Scirpus longii*) in Massachusetts, rare inland populations of dwarf spike rush (*Eleocharis parvula*) in New York, native flatsedge (*Cyperus erythrorhizos*), and the bog turtle (*Clemmys muhlenbergi*) in the northeastern United States (Rawinski 1982; Thompson et al. 1987; Malecki et al. 1993; Skinner et al. 1994). Diverse wildlife and wetland vegetation, including Delta special status plant species and listed wetland-dependent species would similarly be threatened.

The ***complex interface between farm land and water*** in the Bay-Delta estuary *provides rich and varied habitat* for wildlife, especially birds. In the Delta, the principle attraction for waterfowl is winter-flooded agricultural fields. During fall and winter, fields provide a food source and a resting area for migratory birds. Waterways, irrigation canals, and channels feeding these unique systems are at risk. Small mammals also find suitable habitat in the Bay-Delta. Vegetated levees, remnants of riparian forest, and undeveloped islands provide some of the best mammalian habitat in the region. The

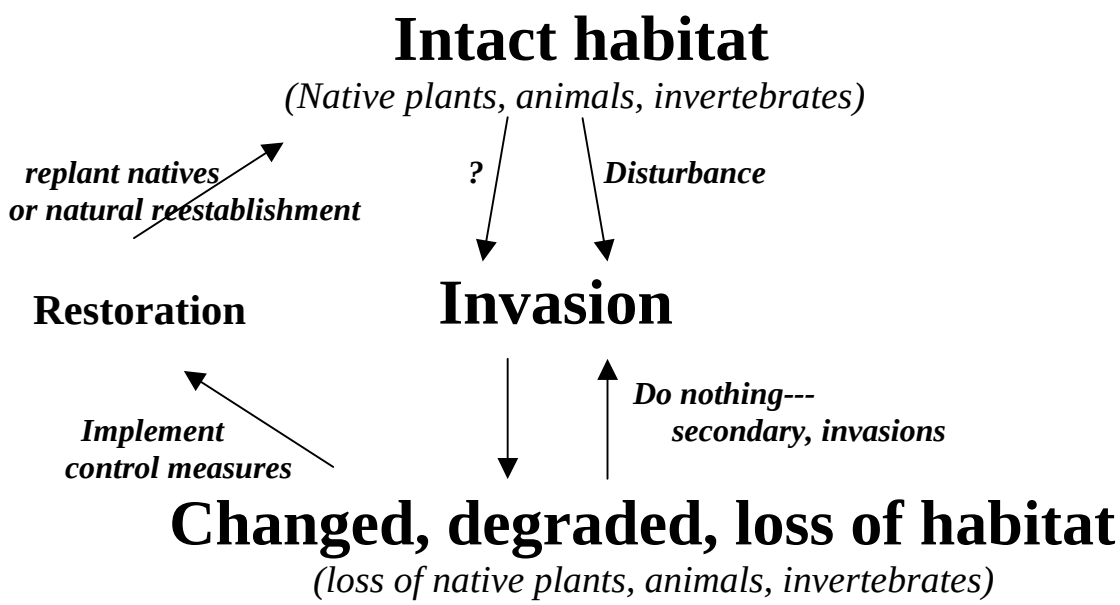
area also supports a variety of non-game wildlife, including songbirds, hawks, owls, reptiles, and amphibians.

Infestations have also been documented to diminish wildlife-related ***recreation*** opportunities such as bird watching, fishing, and hunting (Skinner et al. 1994; Piper 1996).

Compatibility with Non-Ecosystem Objectives
Loosestrife may interfere with wetland functions, including ***productivity*** and ***nutrient cycling*** by replacing mosaics of submergent and emergent vegetation. Leaves of Lythrum have a rapid decay rate resulting in a release of significant amounts of NH_4^+ and $PO4^{3-}$ (Emery and Perry 1995). It is further said that dead loosestrife is not as usable for food by zooplankton and other detritivores as is native wetland vegetation (Skinner et al. 1994). Suppression of the resident plant community eventually leads to the alteration of wetland structure, chemistry, and function (Thompson et al. 1987). The fact that purple loosestrife impedes the rate of natural ***water flow***, causing increased silt deposition and reduction in ***water quality*** has generated substantial concern in western states (Malecki et al. 1993). Loosestrife infestations would also decrease storage capacities of impounded waterbodies.

System-Wide Ecosystem Benefits
Both established and future Floodplain/Restoration and Watershed Stewardship projects will be seriously jeopardized if purple loosestrife is allowed to spread further throughout the Bay-Delta. In addition, experienced crews conducting extensive purple loosestrife surveys in the Delta will be equipped to identify the occurrence of any other aggressive invasive weed populations not previously recorded.

<u>Conceptual Model</u>:



A Hypothesis
The following project presents a general hypothesis, that purple loosestrife is present in multiple locations in the Sacramento-San Joaquin Delta system, and furthermore, that it can be locally

eradicated and contained by implementing an adaptive management program which addresses each infestation with the most appropriate management technique, as determined by CDFA personnel with outside collaborators.

Project Type: FULL-SCALE Implementation/Control Project
In 1999 the CDFA received seed monies to conduct initial "pilot" elements of the project. Elements included: education outreach, survey, mapping, adaptive management planning, initiation of control measures, and monitoring. The proposal presented here presents an expansion and continuation of project elements to date. The emphasis will be on control, therefore launching the project in to a **FULL-SCALE control project.**

3. Approach:

Project Flow
Fall- Mapping and Assessment
Winter- Education Outreach (largely in winter, but continuous throughout year…)
Spring- Planning and Assessment
Summer- Survey, Control and Monitoring

Planning
Annually, regional adaptive management plans will be updated through collaborative stakeholder meetings. Project goals and target objectives will be assessed. CDFA and collaborators will develop treatment and survey schedules during the spring.

Equipment and facilities
The CDFA and cooperators have all essential equipment and facilities necessary to carry out the project. Additional funding for a new GPS unit, canoe racks, and replacement spray equipment would further facilitate the success and efficiency of the project. An airboat purchased at the start of the project has been critical to surveys in that it allows one to access shallow waterways and waterways choked with vegetation. Without an airboat, many sections of the Delta would otherwise be inaccessible.

Project Monitoring:
Consistent with the adaptive management approach, the CDFA and cooperators will continue to monitor three different aspects of the project according to a project monitoring plan (a 31 page management plan with a 54 page appendix was submitted to CALFED June of 2001). Evaluation of the overall treatment and detection hypotheses and the yearly tactical integrated control plan will be ongoing throughout the duration of the project. Specifically we will be addressing:

Treatment efficacy - Depending on which management tools are employed, follow-up will ensure that treatment results in purple loosestrife mortality and/or non-reproduction within the same season as treatment. Treatment success will be monitored through photo points, running transects/quads for plant density and/or numbers before and after treatments at same phenological stage, or monitoring protocols as outlined for biological control establishment. After a foliar application, herbicides often take one or two months to be translocated to the roots and stems. Due to this delay in activity, there is a lag time in determining treatment efficacy. Follow-up will involve a visual assessment after sufficient time has

passed for treatment effects to be adequately measured. Follow-up in terms of biological control, is necessary in both the same season, as well as subsequent seasons, to determine if agents were successfully established. The CDFA has vast expertise in treatment follow-up, inherently a straight-forward activity.

Eradication efficacy - Follow-up in subsequent years, at all treatment sites, will determine population status- i.e. if populations are approaching eradication, containment, or control. Treatment success will be monitored through photo points, running transects/quads for plant density and/or numbers before and after treatments at same phenological stage, or monitoring protocols as outlined for biological control establishment. A visual sampling for both flowering and vegetative plant material will be carried out by trained personnel in a thorough and systematic manner-even if total kill of existing plants is achieved in a given year. Follow-up must be done for at a minimum of five years to ensure that seeds in the soil do not germinate and re-infest the area. The CDFA and cooperators will carry-out follow-up monitoring for the duration of seed viability.

Water sampling - Herbicide applications will be accompanied by both before and after testing for herbicide residues at representative watershed sites. Such precautionary testing will serve as an overall programmatic check. The California Department of Fish and Game's Pesticide Investigations Unit will be contracted again for water sampling analysis. The project budget accounts for individual samples from three sites, for three sampling dates. Because there will many treatments, the sampling will be used as a programmatic check, rather than providing a direct check for every treatment. Where deemed necessary, a NPDES permit will be obtained from the Water Quality Control Board. It should be re-emphasized that all treatments are consistent with state and federal EPA requirements and have been extensively tested for toxicity to fish and amphibians. Furthermore, water samples taken in conjunction with this year's treatments found zero Rodeo or surfactant residue post treatment. In addition, the California Department of Fish and Game's Pesticide Investigations Unit has been testing Rodeo used for Arundo application in semi-aquatic habitats and detailed toxicity tests on larval amphibians and has found a lack of detectable residues post treatment in the water.

Data dissemination

All project data, including updated maps, treatment monitoring results, and water quality monitoring results will be made widely available to all project collaborators. Further, GIS information will continue to be available and shared amongst project partners throughout the watershed. Data will be presented in quarterly CALFED reports, as well as updated annually in regional adaptive management plans. Project status and successes will be also disseminated through talks, training, and educational outreach materials (articles, web site updated, etc.).

4. Feasibility:

The alternative to the current plan is to not take action. Inaction would inevitably result in the continuation of the invasion process, only postponing prevention, detection, and treatment. This alternative is unacceptable due to grave threats to the Bay-Delta wildlands, riparian systems, and endangered species posed by large populations of this explosive weed *(see Ecological/Biological Objectives Section, page 4-5).* Purple loosestrife can spread quickly and with increases in population size there is a greater reliance on herbicide treatments for eradication and the probability of eradication decreases. Alternative control methods for each loosestrife population, addressed in the adaptive management plan, will enable the implementation of best Integrated Weed Management practices/tools, appropriate to each situation.

All currently proposed methods of purple loosestrife management are either inherently benign or have passed through CEQA equivalent environmental reviews. The herbicide Rodeo has been registered in California for over a decade and has passed review by both the US EPA and the California EPA for label compliant usage on aquatic vegetation. CDFA will follow all use restriction requirements recommended by CalEPA in their approval of the material use. The CDFA will consult with the California Department of Fish and Game and the United States Fish and Wildlife Service to determine if additional measures are needed for site specific actions in sensitive habitats (e.g., habitats of threatened and endangered species identified in the Natural Diversity Database). When used in sensitive habitats, water sampling will be conducted by the Pesticide Investigation Unit of the California Department of Fish and Game. Recent water sampling after the use of Rodeo for Giant Cane removal showed concentrations in nearby water far lower that known toxicity to fish and amphibians.

The use of biological control agents for purple loosestrife (*Galerucella calmariensis , G. pusilla, Hylobius transversovittatus, and Nanophytes marmoratus*) have been approved nationally for release by the Technical Advisory Group (TAG) of US Department of Agriculture based on host specificity, after extensive feeding trials on appropriate native and horticultural plants. They have been approved for release in California after testing and review by California Department of Food and Agriculture scientists and regulators.

Project leaders do not foresee any implementation issues/constraints.

5. Performance Measures:

Project Monitoring:
Consistent with the adaptive management approach, the CDFA and cooperators will continue to monitor three different aspects of the project according to a project monitoring plan (submitted to CALFED June of 2001). Evaluation of the overall treatment and detection hypotheses and the yearly tactical integrated control plan will be ongoing throughout the duration of the project. Specifically we will be addressing:

Treatment efficacy - Depending on which management tools are employed, follow-up will ensure that treatment results in purple loosestrife mortality and/or non-reproduction within the same season as treatment. Treatment success will be monitored through photo points, running transects/quads for plant density and/or numbers before and after treatments at same phenological stage, or monitoring protocols as outlined for biological control establishment. After a foliar application, herbicides often take one or two months to be translocated to the roots and stems. Due to this delay in activity, there is a lag time in determining treatment efficacy. Follow-up will involve a visual assessment after sufficient time has passed for treatment effects to be adequately measured. Follow-up in terms of biological control, is necessary in both the same season, as well as subsequent seasons, to determine if agents were successfully established. The CDFA has vast expertise in treatment follow-up, inherently a straight-forward activity.

Eradication efficacy - Follow-up in subsequent years, at all treatment sites, will determine population status- i.e. if populations are approaching eradication, containment, or control. Treatment success will be monitored through photo points, running transects/quads for plant density and/or numbers before and after treatments at same phenological stage, or monitoring protocols as outlined for biological

control establishment. A visual sampling for both flowering and vegetative plant material will be carried out by trained personnel in a thorough and systematic manner-even if total kill of existing plants is achieved in a given year. Follow-up must be done for at a minimum of five years to ensure that seeds in the soil do not germinate and re-infest the area. The CDFA and cooperators will carry-out follow-up monitoring for the duration of seed viability.

Water sampling - Herbicide applications will be accompanied by both before and after testing for herbicide residues at representative watershed sites. Such precautionary testing will serve as an overall programmatic check. The California Department of Fish and Game's Pesticide Investigations Unit will be contracted again for water sampling analysis. The project budget accounts for individual samples from three sites, for three sampling dates. Because there will many treatments, the sampling will be used as a programmatic check, rather than providing a direct check for every treatment. Where deemed necessary, a NPDES permit will be obtained from the Water Quality Control Board. It should be re-emphasized that all treatments are consistent with state and federal EPA requirements and have been extensively tested for toxicity to fish and amphibians. Furthermore, water samples taken in conjunction with this year's treatments found zero Rodeo or surfactant residue post treatment. In addition, the California Department of Fish and Game's Pesticide Investigations Unit has been testing Rodeo used for Arundo application in semi-aquatic habitats and detailed toxicity tests on larval amphibians and has found a lack of detectable residues post treatment in the water.

6. Data Handling and Storage:

All project mapping and monitoring data will be handled and stored by CDFA's GIS lab. CDFA's GIS lab handles the data for all of the Branches control, containment, and eradication projects. Data will be made available to all project cooperators at the Agency, watershed and county levels. To date, data has been shared widely with project cooperators (U.S. Fish and Wildlife Services, Ducks Unlimited, County Agricultural Commissioner's Offices, Weed Management Area groups, etc.).

Base maps have been created for each regional infestation. New survey, treatment, and monitoring data are being added in separate layers to these base maps. Maps are supplied to CALFED with January quarterly reports of each year. Updated maps are also made widely available to regional partners.

All water quality monitoring data will be collected, analyzed, and handled at the CA Department of Fish and Game's Pesticide Investigations Unit Laboratory in Rancho Cordova. Results will be supplied to CDFA and then reported quarterly to CALFED through quarterly reports.

7. Expected Products/Outcomes:

Expanded Prevention, Detection and Control OBJECTIVES THREE FOLD:

1) **A continued exhaustive yearly survey and mapping of the Sacramento-San Joaquin Delta.** A comprehensive annual survey and mapping of the Sacramento-San Joaquin Delta and associated hydrological units will be continued. It is important to note that while surveying for purple loosestrife, CDFA staff is also on the look-out for any new non-native species, plants and invertebrates. Early detection and prevention of new pests, single individuals or small patches, is the most environmentally and economically sound approach in pest prevention.

2) **Continued and expanded local eradication, control, and containment of loosestrife in the Core Delta and associated CALFED Bay-Delta hydrological units.** Based on regional adaptive

management plans, management techniques will continue to be implemented and expanded into newly infested areas. An integrated pest management approach is utilized. Where applicable, hand-removal-by digging with shovels takes place early in the season (May-July) as to not spread seed. Where appropriate, spot treatment with Rodeo takes place throughout the growing season (pre-bloom through senescence). In Shasta and Butte Counties, biological control agents are released in the early spring so that several generations may result from egg laying adults.

3) **An expanded education outreach and training campaign** of the boating, fishing, water fowl hunting, watershed groups and similar public citizenry. Training of agency personnel and public departments (Irrigation Districts, Mosquito Abatement Districts, and Public Works crews), working in and near the Delta, to recognize purple loosestrife and other aquatic nonnative invasive species will also be continued. The key to early detection and prevention is getting as many eyes out there looking for the pest. Last year, three new infestations were found in the Delta as a direct result of education outreach and training.

An Expansion of Project Goals:

- While treatment just got underway this summer, treatments results are looking promising. It would be a shame to loose ground on control, containment, and local eradication successes accomplished to date. With additional funding, purple loosestrife can be prevented from taking over California's waterways as seen in the northeastern U.S. Rarely does such an opportunity present itself in weed control.

- Education outreach efforts will continue, teaching the general public and additional agency personnel the threats that aquatic invasive species pose to California's waterways. It was through purple loosestrife outreach and trainings over the course of the past two years that several new infestations of purple loosestrife and a few other aquatic invaders were identified.

- Treatments this summer have significantly reduced plant numbers/densities and with additional years of treatment, will continue to shrink populations and exhaust the seed bank.

- With additional years of treatment purple loosestrife can be significantly reduced if not entirely eradicated from heart of the Sacramento San Joaquin Bay-Delta.

- It is anticipated that infestation in White slough, Ryer Island, Old, Middle, Calaveras, and San Joaquin Rivers can be completely eradicated within three years.

- The Tuolumne River infestation serves as the biggest challenge in the core Delta and will require the most resources to eradicate.

- With continued treatment, purple loosestrife can be further reduced, controlled, contained, and locally eradicated in associated Hydrological Units throughout the Bay-Delta Watershed.

- The project will continue to add to CDFA's purple loosestrife historical records database as well as build upon a set of regional purple loosestrife base maps. Survey and detection data are recorded using GPS and filed into a Department database. New infestation finds, as well as negative or "no" finds are recorded. Negative find data is equally important not only over the course of the project, but well into

the future. Future project managers will have a historical database---20, 40, 60 years down the road---which will be key in assessing the feasibility and prioritization of future aquatic invaders.

8. Work Schedule:

Table 1- Proposed Work Schedule
PHASE III- Expanded Prevention, Detection and Control Project

Task	*Description of Task*
Expanded EDUCATION OUTREACH ***TIMEFRAME: Throughout the duration of the project, talks given largely during fall and winter months and training given in the field during summer (plant blooming months).***	
Task 1 – Expanded Educational Outreach ***SEPTEMBER-MARCH***	Educational talks to boating, fishing, water fowl hunting, watershed groups, and similar public citizenry.
Task 2 – Ongoing Training of Professionals ***MAY-AUGUST***	Training of agency and public department personnel working in and near the Delta.
Continued DETECTION PROGRAM- Survey crews to conduct: ***TIMEFRAME: Throughout the duration of the growing season when plant is blooming because this is when its showy red-purple spikes of flowers are most easily detectable.***	
Task 3- Continued Delta Wide Survey ***JUNE-AUGUST***	Complete detection and survey for purple loosestrife and other aquatic pests in the "heart of the Delta," waterways in Sacramento, San Joaquin, and Stanislaus Counties.
Task 4- Continued Contiguous Basin Survey ***JUNE-AUGUST***	Complete detection and survey for purple loosestrife and other aquatic pests in contiguous basins throughout the CALFED Watershed. Waterways in Shasta, Butte, Sutter, Yuba, Nevada, Placer, Fresno, Yolo Counties.
Continued GPS/GIS MAPPING ***TIMEFRAME: After the height of the growing season and thus data collection---during fall and winter months.***	
Task 5 – Update of GIS system and Maps	Update, add treatment and monitoring layers to existing regional maps.

Continued and Updated PLANNING

***TIMEFRAME*: After the height of the growing season and therefore data collection and map development--- during fall and winter months when most people in plant and agriculture fields are available for meetings.**

Task 6- Update adaptive management plans ***OCTOBER-MARCH***	Reevaluate and update regional adaptive management plans through collaborative assessment meetings.
Task 7- Environmental consultation and planning ***FEBRUARY-MAY***	Environmental consultation and planning of treatments.

Continued and Expanded IMPLEMENTATION OF CONTROLS

***TIMEFRAME*: Mostly throughout the duration of the growing season JUNE-AUGUST when plant is blooming because this is when its showy red-purple spikes of flowers are most easily detectable. Early season control in MAY could be implemented to target small, early plant growth. Late season control in SEPTEMBER and OCTOBER is also applicable in some instances to maximize translocation of herbicide into the roots (in the fall loosestrife sends carbohydrates down to its roots, taking herbicide applied with it).**

Task 8 –Implementation of Controls ***MAY-OCTOBER***	Continued and expanded local eradication, control, and containment. Appropriate form of control assigned to each infestation. Integrated methods include: mechanical removal, herbicide (Rodeo), and biological controls.

ASSESSMENT AND MONITORING

***TIMEFRAME*: At the same time that treatments are made and implemented. Monitoring being conducted before and after treatment at the same phenological stage of flower development to ensure comparisons between years.**

Task 9 –Continued Monitoring of Control measures ***MAY-OCTOBER***	Monitor treatment success through photo points, running transects/quads for plant density and/or numbers before and after treatments at same phenological stage, or monitoring protocols as outlined for biological control establishment.
Task 10 – Continued Monitoring of Water Quality ***MAY-OCTOBER***	As a programmatic check, conduct water quality sampling at representative herbicide treatment sites. Where necessary, protocols approved by the Water Quality Control Board.

B. Applicability to CALFED ERP and Science Program Goals & Implementation Plan

1. ERP, Science Program Priorities:

***Invasive species**, and **purple loosestrife** in particular are mentioned repeatedly as priorities in the* Multi-Regional Bay-Delta Areas section, as well as specifically addressed in the: Sacramento, San Joaquin, Delta, and Bay Regions. Priorities call for: purple loosestrife mapping, annual survey, outreach, implementation of control and eradication, assessment of control efforts, and prevention. All of these priorities would be met by this continued and expanded project proposal. *Please see below sections for direct applicability---language taken directly from priority areas of PSP.*

Restoration priorities for the Multi-Regional Bay-Delta Areas [MR-PRIORITY #1]:
Prevent the establishment of additional nonnative species and reduce the negative biological, economic, and social impacts of established nonnative species in the Bay-Delta estuary and its watersheds.

*Building on existing CALFED **Purple Loosestrife** mapping and outreach project to further support the development and implementation of loosestrife control and eradication management plans.
*NIS control and eradication projects: **Purple loosestrife** (*Lythrum salicaria*) is included on a priority focus list of species.
*Initiate a comprehensive system-wide annual survey.
*Implement NIS detection, monitoring, and control programs.
*Develop and evaluate integrated methods of NIS Control, using physical, chemical and biological techniques.
*Assess success and impacts of control efforts.
*Prevention: prevention of additional non-native invasive species--- in our continued annual survey we are also on the look-out for any new plant or invertebrate nonnative species.

***Sacramento Region* [SR-PRIORITY #5]:**
Continue actions and studies related to nonnative invasive species.

San Joaquin Region* [SJ-PRIORITY #4]*:
Continue actions and studies related to nonnative invasive species.

*Non-native Invasive Species. Projects are needed to implement an eradication program for **purple loosestrife** along the Tuolumne River.

Delta Region* [DR-PRIORITY #5]*:
Implement actions to prevent, control and reduce impacts of non-native invasive species in the Delta.

*High priority is given to surveys, studies, eradication efforts and monitoring effort for nonnative species in the Delta.
*Methods for comprehensive mapping, system-wide surveys and/or on-going monitoring of specific invasive species.

Bay Region* [BR-PRIORITY #3]*:
Implement actions to prevent, control and reduce impacts of non-native invasive species.

2. Relationship to Other Ecosystem Restoration Projects:
Direct relationship to previously funded CALFED Project, see part 4 of this section. No direct relationship to other invasive species Ecosystem Restoration projects--- other than during surveys new occurrences of any invasive exotics (mitten crab, hydrilla, etc.) are reported and mapped with GPS.

3. Requests for Next-Phase Funding:
Please note that this project proposal is not requesting a new phase of funding. Rather, proposed is an expansion and continuation of current phases and objectives of the project (please see response to part 4 of this section, immediately below). To date, the CDFA has **met and exceeded all** project goals. All quarterly and fiscal reports have been submitted on time and have been thorough.

Please note: deliverables submitted over the past two years, are numerous (over 50 individual items) and are in all sorts of shapes, sizes, and formats. Namely, maps--- multiple maps per region have been produced and many are poster size and therefore not easily submitted with this electronic submittal. I have included only 5 maps with this proposal--- these maps are broad overviews of the heart of the delta and overview of the entire watershed. Both CALFED contract managers (USFWS and NFWF) have copies of all regional maps and will hopefully make them available if necessary in evaluation of this proposal. We have received continued complements from contract managers on our many maps submitted as deliverables with quarterly reports.

4. Previous Recipients of CALFED Program Funding:
To specifically address the spread of this aggressive wetland invader, the California Department of Food and Agriculture submitted 3-year proposals in 1999 to both a CALFED Directed Action Solicitation and a General Solicitation.

Project Phases: CDFA was solicited (4/5/99) to implement a "directed action" by the CALFED Non-native Invasive Species Program (NISP) for the prevention and eradication of purple loosestrife with a primary focus of detection and eradication in the Delta. Because the directed action was only tentative and did not address protection of the whole CALFED watershed, CDFA was advised to submit a proposal through the General Solicitation Process for the full amount of a CALFED Watershed-Wide project, but to break the proposal into **two phases** which separate the proposed contract for the directed action and the extra work plan to protect the whole watershed. These two phases were referred to as **Phase I** and **Phase II.** Although this terminology connotes a temporal sequence, it actually refers to a geographic separation that reflects distance for the Sacramento-San Joaquin Delta system and the funding limitations of the directed action.

**CALFED Directed Action Solicitation (PHASE 1, Core Delta)-*
Title: Purple Loosestrife Prevention, Detection, and Control Actions for the Sacramento-San Joaquin Delta and Associated Hydrological Units
Project number: 99-F08, managed by USFWS

**General Solicitation (PHASE II, Expanded to entire CALFED Bay-Delta Watershed)-*
Title: Purple Loosestrife Prevention, Detection, and Control Actions for the Sacramento-San Joaquin Delta System and Associated Hydrological Units
Project number: 99-N11, managed by NFWF

Grants were awarded in 1999 and we are currently entering our last year of funding. Through a highly collaborative effort with many state (Calif. Dept. of Fish and Game, Calif. Dept. of Boating and

Waterways, Calif. Dept. of Water Resources, Calif. State Parks) and federal (U.S. Fish and Wildlife Services, U.S. Dept. of Agriculture, U.S. Bureau of Reclamation) agency partners, as well as cooperation of local watershed and weed management area groups, **accomplishments over the past two years have included:**

YEAR 1 ACCOMPLISHMENTS:

- A far-reaching education outreach campaign: development and distribution of a brochure, launching and updating of a website, and presentations/training to over 60 groups.
- A comprehensive survey and mapping effort in Shasta, Butte, Sutter, Yuba, Nevada, Placer, Sacramento, San Joaquin, Stanislaus, Fresno, and Yolo Counties (SEE attached Bay-Detla Watershed MAP).

YEAR 2 ACCOMPLISHMENTS:

- Development of Regional Adaptive Management Plans through collaborative meetings.
- Initiation of a treatment program: control, containment, and eradication.
- Initiation of a monitoring program: treatment success and water quality assurance.

Implementation, Full Scale: ***Expansion and continuation of purple loosestrife prevention, detection, and control***

To date, we have met and exceeded all project goals. At the start of project, White Slough was the only known purple loosestrife infestation in the Core Delta (Sacramento/San Joaquin Counties). As a result of this project, five additional populations have been located in the heart of the Delta (Sacramento, San Joaquin, and Stanislaus Counties) (SEE enclosed Delta Maps 2, 3, 4, and 5). An extensive infestation was found infesting the Tuolumne River ---this infestation is a direct seed source threatening further expansion in the south delta. Expanded and/or new infestations were also found in associated Hydrological Units within the entire CALFED Bay-Delta watershed.

An Expansion of Project Goals:

While treatment just got underway this summer, treatments results are looking promising. Most infestations are small and scattered and therefore can be locally eradicated. With additional years of treatment purple loosestrife can be significantly reduced if not entirely eradicated. It is anticipated that infestation in White slough, Ryer Island, Old, Middle, Calaveras, and San Joaquin Rivers can be completely eradicated within three years. The Tuolumne River infestation serves as the biggest challenge and will require the most resources to eradicate. Treatments this summer have significantly reduced plant numbers/densities and with additional years of treatment, will continue to shrink populations and exhaust the seed bank.

It would be a shame to loose ground on control, containment, and local eradication successes accomplished to date. With additional funding, purple loosestrife can be prevented from taking over California's waterways as seen in the purple plagued northeastern United States.

5. System-Wide Ecosystem Benefits:

The displacement of valued ***flora and fauna*** and the diminishment of critical fish and wildlife habitats has been well documented throughout the United States. In many States, loosestrife makes up more than 50% of the biomass of emergent vegetation causing canopy closure that results in a virtual biological "desert" underneath. Research has shown that common emergent aquatics such as cattails

(*Typha* spp.), sedges (*Carex* spp.), and smartweed (*Polygonum* spp.), and floating plants such as *Potamogeton spp.,* and *Lemna minor* cannot successfully compete with loosestrife (Thompson et al. 1987; Weihe and Neely 1997; Fernberg 1998). A literature review also reveals that dramatic changes in the physical as well as the trophic structure of wetland habitat has threatened the following wildlife species: Muskrat, mink, Canada goose, fox, wood duck, mallard, black tern, canvasback, and sandhill (Coddington and Field 1978; Malecki et al. 1993; Skinner et al. 1994). Complex food webs that are maintained by a diversity of native wetland plants and aquatic habitats become simplified or excluded. Animals that rely on the native vegetation for food, shelter, breeding and nesting areas cannot use these heavily infested areas (Skinner et al. 1994; Thompson et al. 1987).

Fish species will also be affected. The rapid decay rate of purple loosestrife leaves has been shown to supply detritus to the ecosystem in Autumn, whereas a much slower decay rate of resident vegetation supplies detritus throughout the winter and early spring (Grout et al. 1997). Consumer organisms important in juvenile Salmon food webs appear to be adapted to take advantage of the detritus provided in these later seasons. In addition, submersed terrestrial vegetation that provides habitat for spawning and zooplankton critical to early survival, will be crowded-out by the establishment of loosestrife (Skinner et al. 1994).

Loosestrife has also jeopardized various ***threatened and endangered*** native wetland plants and wildlife such as a local bulrush (*Scirpus longii*) in Massachusetts, rare inland populations of dwarf spike rush (*Eleocharis parvula*) in New York, native flatsedge (*Cyperus erythrorhizos*), and the bog turtle (*Clemmys muhlenbergi*) in the northeastern United States (Rawinski 1982; Thompson et al. 1987; Malecki et al. 1993; Skinner et al. 1994). Diverse wildlife and wetland vegetation, including Delta special status plant species and listed wetland-dependent species would similarly be threatened.

The ***complex interface between farm land and water*** in the Bay-Delta estuary *provides rich and varied habitat* for wildlife, especially birds. In the Delta, the principle attraction for waterfowl is winter-flooded agricultural fields. During fall and winter, fields provide a food source and a resting area for migratory birds. Waterways, irrigation canals, and channels feeding these unique systems are at risk. Small mammals also find suitable habitat in the Bay-Delta. Vegetated levees, remnants of riparian forest, and undeveloped islands provide some of the best mammalian habitat in the region. The area also supports a variety of non-game wildlife, including songbirds, hawks, owls, reptiles, and amphibians.

Infestations have also been documented to diminish wildlife-related ***recreation*** opportunities such as bird watching, fishing, and hunting (Skinner et al. 1994; Piper 1996).

6. Additional Information for Proposals Containing Land Acquisition:
Not Applicable to this project.

C. Qualifications
California Department of Food and Agriculture
The California Department of Food and Agriculture (CDFA) has statutory responsibility for the prevention of exotic agricultural and environmental pests from entering the State. The CDFA is concerned with invasive weeds, insects, animals, and diseases. The Department's pest prevention strategy consists of four major components:

1) *Exclusion*- preventing exotic pests from entering California

2) *Detection*- locating existing pest populations
3) *Eradication*- eliminating existing pest populations
4) *Education*, informing the public about the importance of keeping California pest-free.

Integrated Pest Control Branch
Pest prevention is a major part of the California Department of Food and Agricutlure's many different functions, particularly in the Plant Health and Pest Prevention Service (PHPPS). PHPPS is divided into four branches, including the Integrated Pest Control Branch (IPC). The IPC has four major programs that are directly involved in weed control:

1) *Weed and Vertebrate Program*
2) *Hydrilla Eradication Program*
3) *Biological Control Program*
4) *Noxious Weed Information, Mapping, and GIS Project*

IPC works closely with the County Agricultural Commissioner Offices, local Weed Management Areas (local weed management action and coordination groups) and other State and Federal agencies in prevention, education, detection, and control efforts. The Integrated Pest Control Branch has a long history of weed management actions and has taken the lead in noxious weed prevention, detection, education, and control in California. The Weed and Vertebrate Program is largely focused on the detection and eradication of A-rated, listed State Noxious Weeds. This group surveys the entire Delta annually (for hydrilla -at a time too late for loosestrife) and thus will serve as an invaluable resource in purple loosestrife detection and mapping. The Hydrilla Program is very similar, but focuses on a specific aquatic weed of special concern. This program, which has similar components/structure to our proposed Purple Loosestrife Project, has shown great success, hydrilla has been eradicated from 9 out of 17 infested Counties and is nearing eradication in the others. The Biological Control Program, in cooperation with the USDA and the University of California, brings natural enemies of pests into the State to permanently reduce pest populations. This group is in its fourth year of carrying out purple loosestrife biological control agent test releases in California. The Noxious Weed Information, Mapping, and GIS Project has developed a GIS and database system for mapping and tracking A-rated weed populations. This group has also facilitated formation of local Weed Management Areas throughout the State and produces a quarterly interagency weed control newsletter sent to 1,800 subscribers, the "Noxious Times."

Nathan Dechoretz, Principle Investigator
Experience includes over 30 years working in the field of aquatic weed control. Received B.S. in Biological Science from the University of Arizona in 1967. From 1967 to 1987 managed and conducted research at the USDA Aquatic Weed Control Research Laboratory in Davis, CA. From 1987 to 2000 served as Program Supervisor for the Weed and Vertebrate Control, Hydrilla Eradication and Biological Control Programs, and the Weed Information, Mapping, and GIS Project at the CDFA. Since the spring of 2001 has served as the Branch Chief of the Integrated Pest Control Branch. Has successfully organized and conducted research on hydrilla, water hyacinth, as well as, many other noxious weeds. Has conducted numerous workshops, given countless presentations, and has authored/co-authored over 50 publications, abstracts, and reports in the field of weed management. Has served as Chair of the California Interagency Noxious Weed Coordinating Committee and as a lead member of the Western Weed Coordinating Committee. Is also a member of the Weed Science

Society of America, Western Society of Weed Science, Western Aquatic Plant Management Society, and Aquatic Plant Management Society.

Steve Schoenig, Project Manager, Co-Principle Investigator
Has 18 years experience in the fields of biological pest control weed education/research. In 1981 received B.S. in Biology of Natural Resources from UC Berkeley. At UC Davis earned two Master's degrees in Statistics and Entomology in 1981 and 1987, respectively. From 1991 to 1995 provided Departmental statistical consultation and implemented biological pest control projects/studies while serving as Associate Environmental Research Scientist with the Biological Control Program at CDFA. 1996 to present, serves as lead Senior Environmental Research Scientist for the Weed Information, Mapping, and GIS Project within the Integrated Pest Control Branch at the CDFA. Duties include: supervising 6 people, oversees mapping, database, education, research, and interagency weed management coordination projects. Has given countless presentations on weed education/control, authored/co-authored over 20 publications. Currently a board member of the California Exotic Pest Plant Council, and a member of the American Statistical Association, and the California Native Plant Society.

Carri Benefield, Project Coordinator
Graduated in 1996 from Saint Mary's College of California with a B.S. in Biology. Spring of 1998 earned a Master's Degree in Plant Biology, emphasis in Weed Science, from UC Davis. Fall 1998 to Fall 1999, served as a Scientific Aid for the CDFA and as Field Crops Outreach Coordinator with the UC Sustainable Research and Education Program, Davis CA. From fall of 1999 to present serves as Associate Agricultural Biologist with CDFA. Associate Agricultural Biologist duties include: Purple Loosestrife Project Coordinator, Co-lead in promotion and development of Weed Management Area groups across the State, Weed Education and Outreach Coordinator, and Editor of the Noxious Times Newsletter. Has conducted, organized, and/or led research on yellow starthistle, cape ivy (formerly known as German ivy), Scotch thistle, and French broom. Currently a member of the California Exotic Pest Plant Council, California Weed Science Society, and Western Society of Weed Science. Has conducted over 50 presentations and trainings to regional purple loosestrife working groups, agency staff, local watershed groups, Weed Management Area groups, as well as at the above mentioned Societies. Has two published manuscripts (California Agriculture and Weed Science), one manuscript under review (Weed Technology), and 20 abstracts. Was a contributor of a chapter on purple loosestrife to a book entitled: "Invasive Plants of California's Wildlands" (2000, UC Press).

D. Cost

Budget: Budget included on web forms as required. A nicely formatted Excel spreadsheet is available upon request.

Cost Sharing: The project is a highly cooperative effort and a good deal of in-kind support is provided by cooperators. No hard-dollar matches are anticipated at this time.

E. Local Involvement

County Agricultural Commissioners often share or take the lead role with the CDFA on all County weed projects. In line with this historic partnership, the Counties have been active participants of the project and are in full support of its continuous and expansion.

We will also continue working closely with our own local **CDFA Integrated Pest Control Branch District Weed Eradication Biologists**. They will be assisting with the detection and eradication work in-kind as well as providing usage of boats and trucks.

Local Weed Management Areas

The Integrated Pest Management Branch has taken a lead role in the promotion and coordination of county-wide Weed Management Areas (WMAs). They are local weed management groups made-up of concerned citizens, members from private groups and State, Federal, County Agencies. Groups sign memoranda of understanding, hold regular meetings, formulate weed management plans, and conduct a wide range of weed prevention, education, detection, and control projects. WMAs have been very supportive of the project to date and have expressed a real interest in continuing to do so.

State and Federal Agencies

Collaboration has and will continue to include, employees of the following agencies: California Department of Fish and Game, California Department of Boating and Waterways, California State Parks and Recreation, US Bureau of Reclamation, US Fish and Wildlife Service, and US Department of Agriculture.

Other Supporters

Support for the project has been and will continue to be wide: Chapters of the California Native Plant Society (CNPS), members of the California Exotic Pest Plant Council, many Resource Conservation Districts (RCDs), Duck's Unlimited, Homeowner Associations, watershed groups, mosquito abatement districts, public works departments, and private citizens. Property access has been facilitated through the County Agricultural Commissioners office and local RCD if on private land.

F. Compliance with Standard Terms and Conditions

The California Department of Food and Agriculture WILL comply with (and has complied with a prior grant award in 1999) the standard State and Federal contract terms described in Attachments D and E.

G. Literature Cited

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Emery, S.L. and J.A. Perry, 1996. Decomposition rates and phosphorus concentration of purple loosestrife and cattail in 14 Minnesota wetlands. Hydrobiologia 323(2):129-138.

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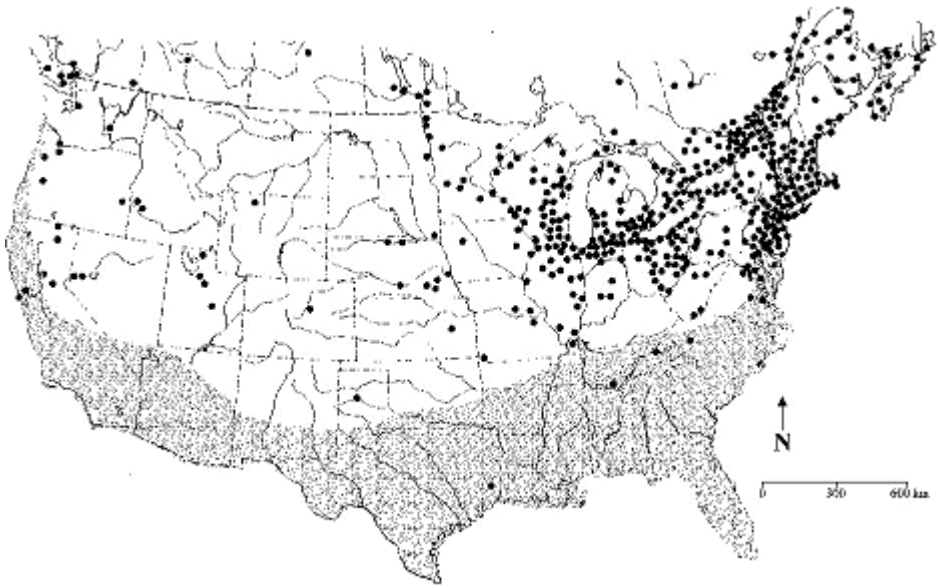
Rawinski, T.J. 1982. The ecology and management of purple loosestrife in New York. Master's thesis, Cornell Univ.

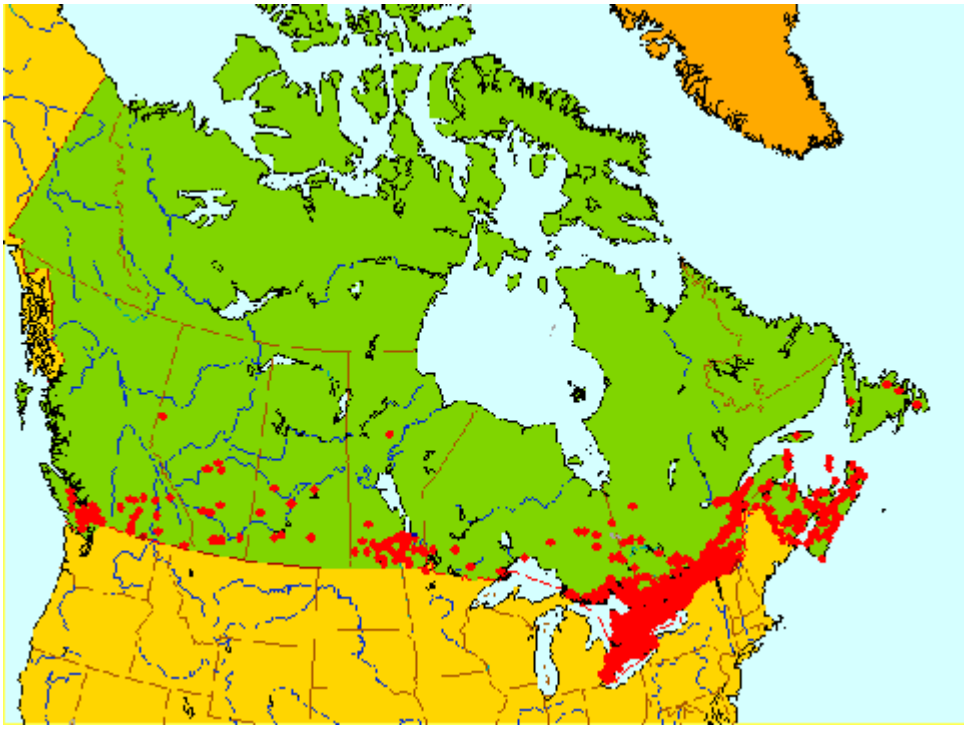
Skinner, L.C., Rendall, W.J., and Fuge, E.L., 1994. Minnesota's purple loosestrife program: history, findings, and management recommendations. Minn. Dept. Nat. Res. Special Publ. 145:1-27.

Thompson, D.Q., R.L. Stuckey, and E.B. Thompson, 1987. Spread, impact, and control of purple loosestrife in North American wetlands. Fish and Wildlife No. 2 U.S. Dept. Interior, Fish and Wildlife Service, Washington, D.C. 55 pp.
Weihe, P.E. and R.K. Neely, 1997. The effects of shading on competition between purple loosestrife and broadleaved cattail. Aquatic Botany 59(1-2):127-138.

WHAT CALIFORNIA IS TRYING TO PREVENT:
Total Invasion as seen in North Eastern U.S. and Canada.

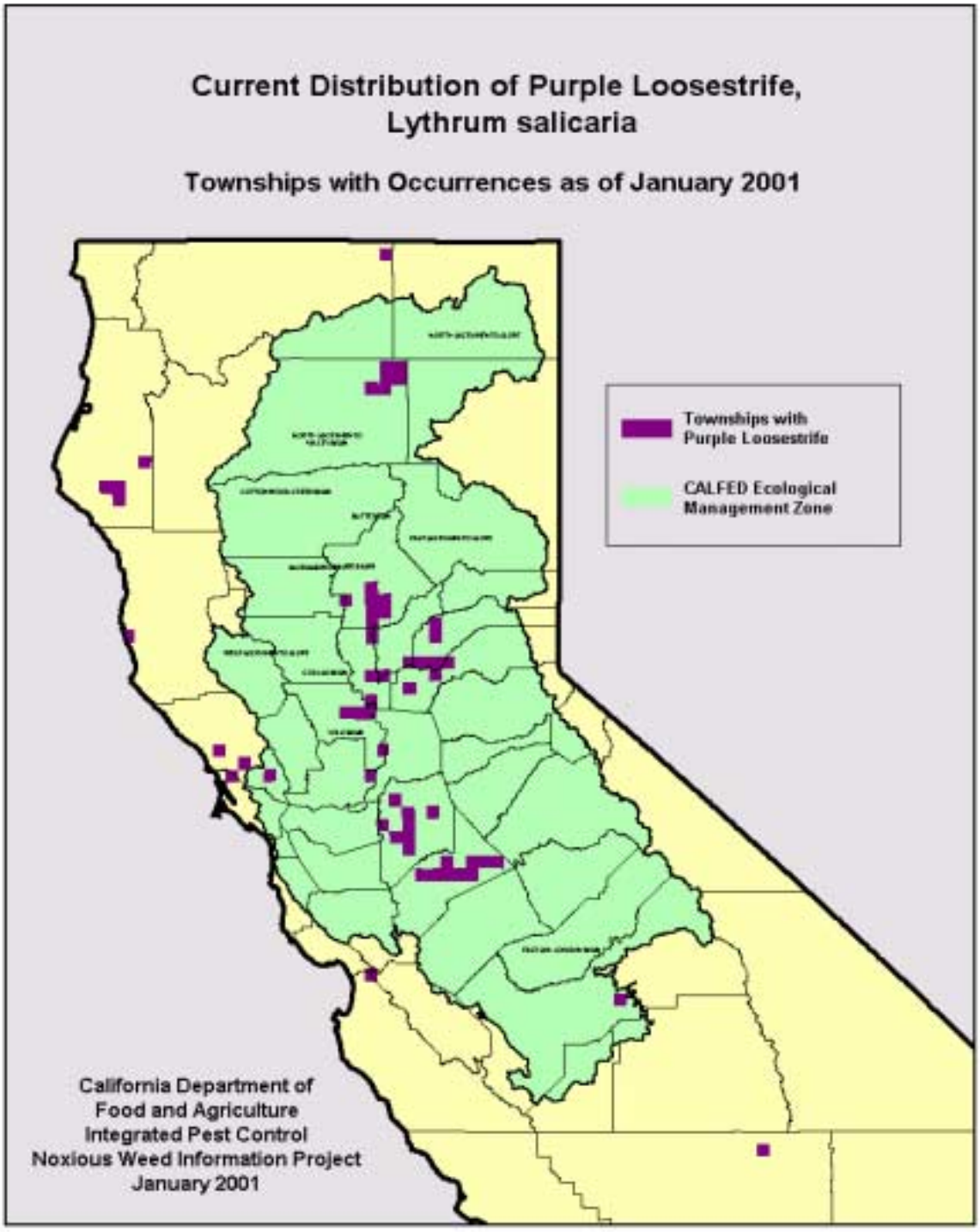


U.S. Distribution of Purple Loosestrife, late 1980s.

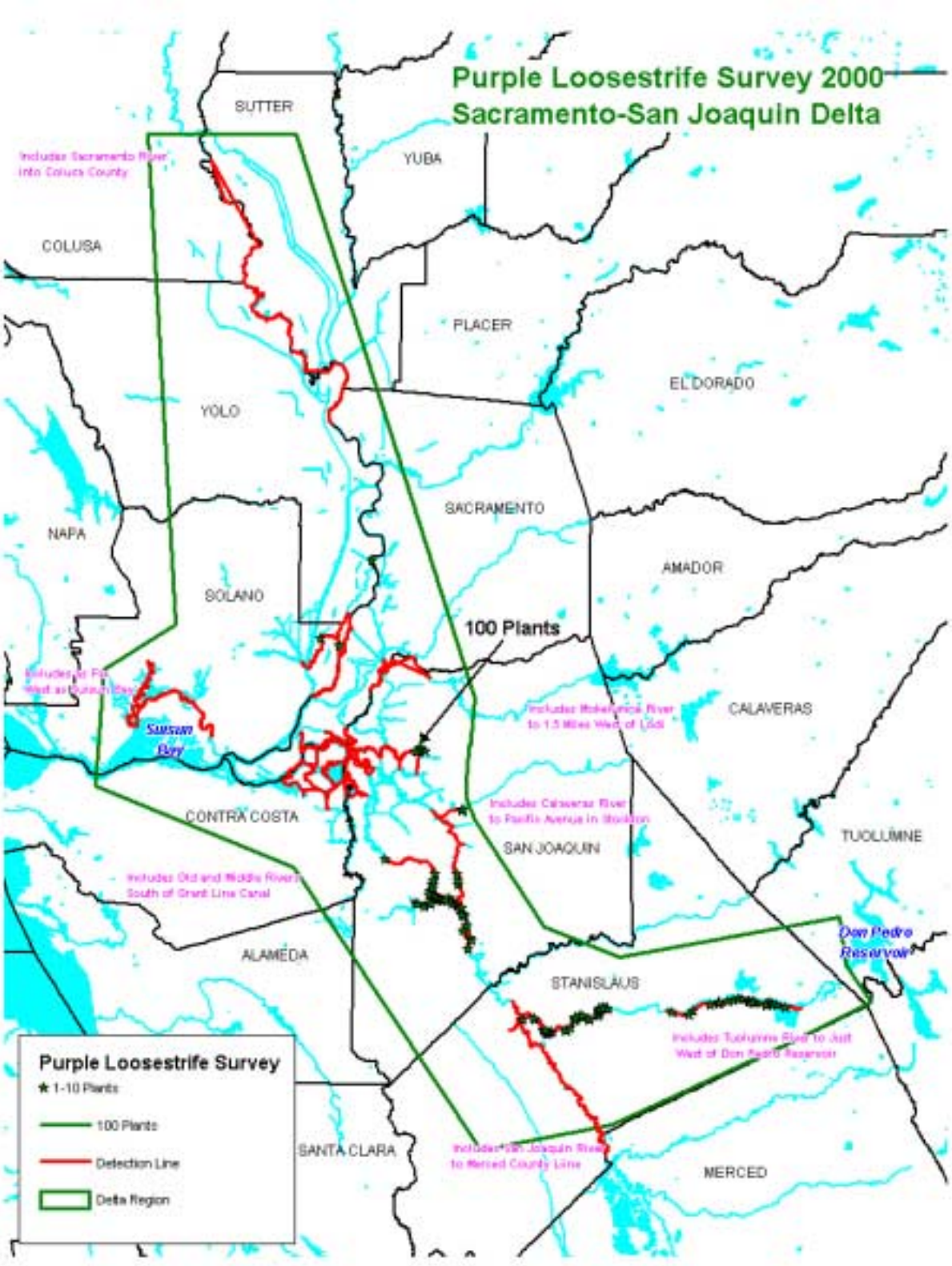


Canadian Distribution, as of early 1990s.

Map 1

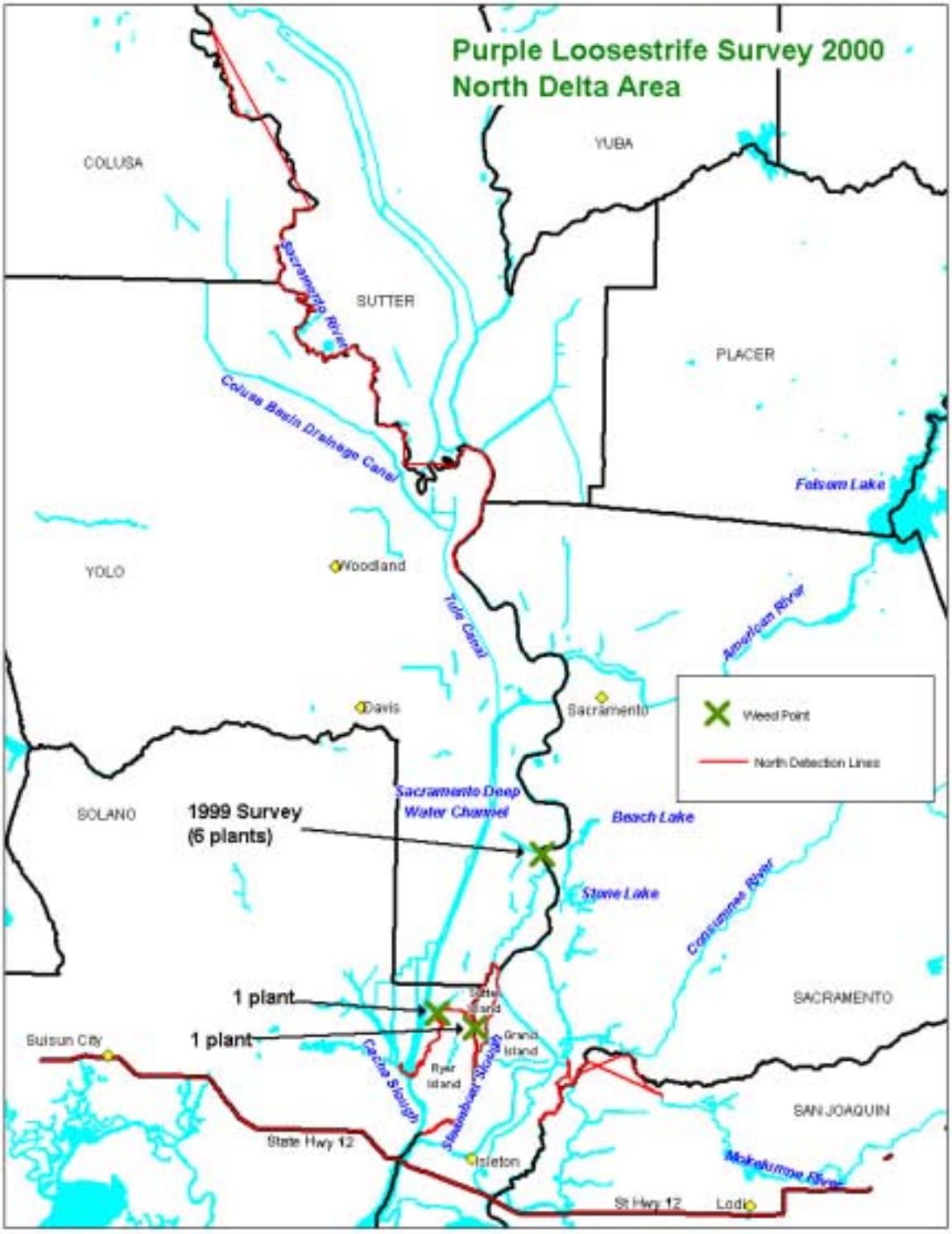

Current Distribution of Purple Loosestrife,
Lythrum salicaria
Townships with Occurrences as of January 2001
Townships with Purple Loosestrife
CALFED Ecological Management Zone
California Department of Food and Agriculture
Integrated Pest Control
Noxious Weed Information Project
January 2001

Map 2



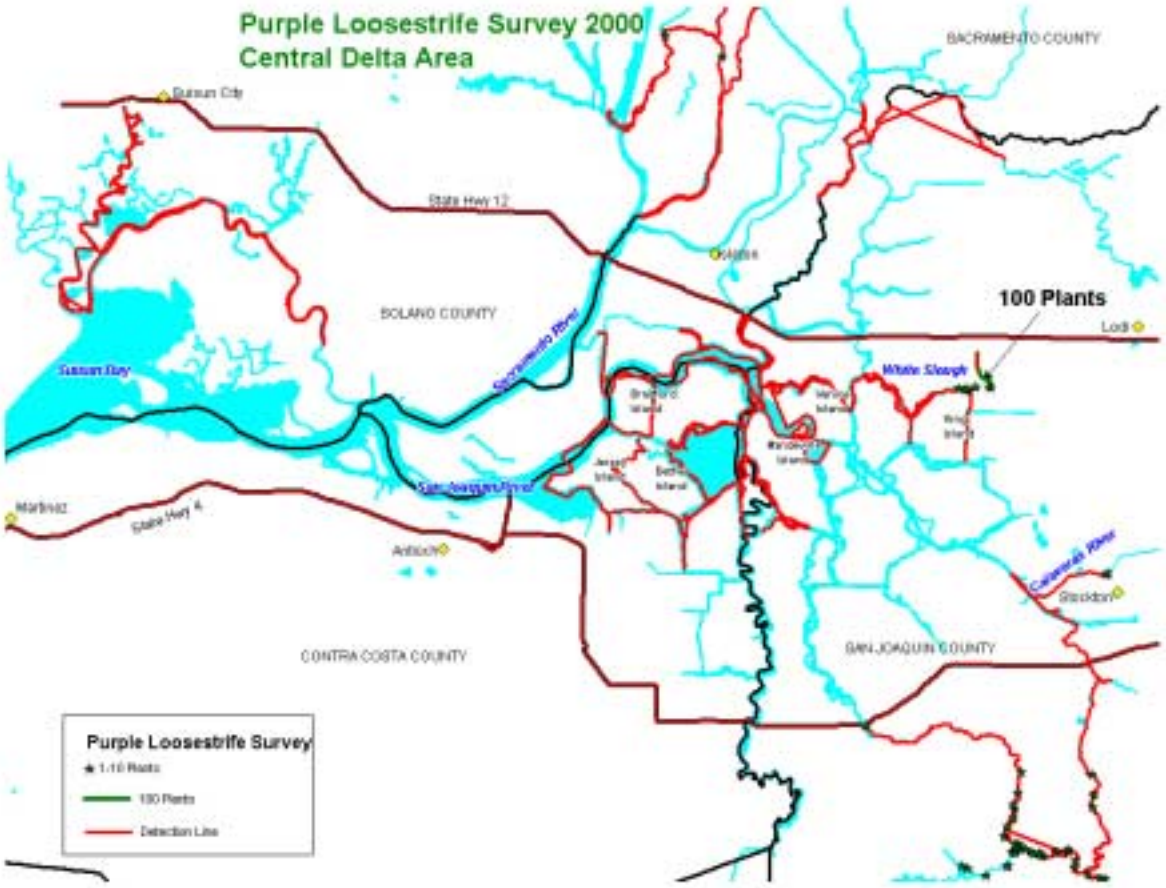
An Overview of purple loosestrife infestations in the Heart of the Delta: Sacramento, San Joaquin, and Stanislaus Counties.

Map 3



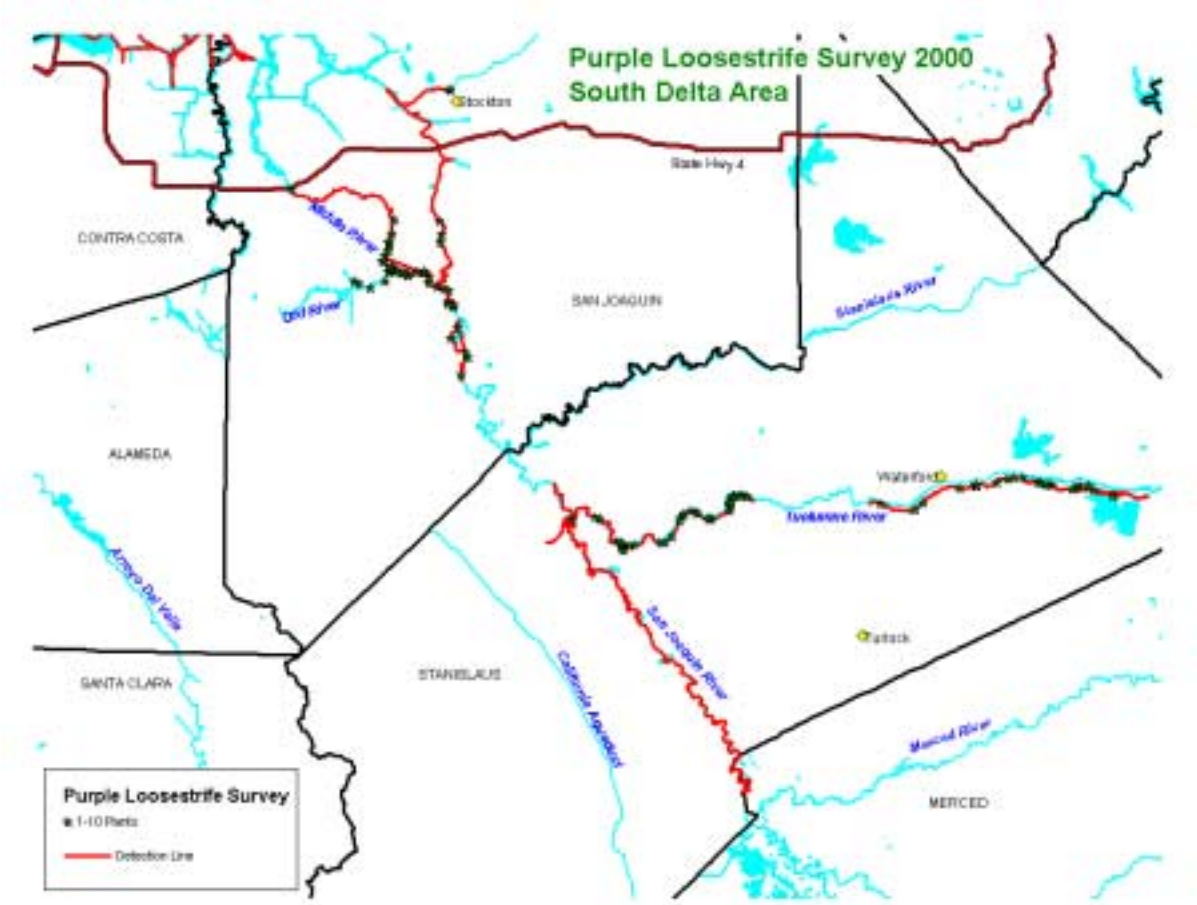
Five NEW purple loosestrife sites found. The first site was scattered, isolated plants found along the Sacramento River. The second new site revealed plants found on either side of Ryer Island. *See maps 3, 4 and 5 for three other new sites.*

Map 4



White Slough was the only know infestation prior to the project. The third new site, plants found along the Calaveras River and out near Linden.

Map 5



The fourth new site is an infestation along the Old/Middle Rivers. The fifth new site is along the Tuolumne River, the largest site found in the heart of the Delta, a site threatening further spread through the south/central Delta.

SURVEY FOR INVASIVES IN THE WATERSHED

Airboat was vital accessing much of the watershed.

By Canoe in Cache Creek.

Road Side surveys in Butte County ditches.

By air in Yolo and Nevada Counties.

NEW INFESTATION IN THE HEART OF THE DELTA

Sacramento, San Joaquin, and Stanislaus Counties

The largest infestation was found in the South Delta on the Tuolumne River---
a seed source that threatens the entire South Delta if not addressed.

An infestation found in a ditch near Linden.

White Slough was the only know infestation
prior to project surveys.

Confluence of Middle and Old Rivers, San Joaquin County
July 2000 Survey and Treatment, Two very large plants.

Confluence of Middle and Old Rivers, San Joaquin County
At the same location, close up shot and shot zoomed out, July 2001---1 year post treatment
No Purple loosestrife to be found, two large plants gone, delta vegetation filled in the gaps.

MORE SHOTS FROM THE HEART OF THE DELTA

Isolated, single plant found and treated.

Post Treatment, single plant dying.

Another isolated plant found and treated in the Delta.

Plant, difficult to dig in the rock, rip-rap. So, spot treatment with Rodeo must be used.

A Photographic Snapshot of Select Locations in Contiguous Waterways of the CALFED Bay-Delta Watershed

Butte County, Thermalito Forebay
Before Treatment, July 2001

Butte County, same location at forebay
After Treatment, September 2001
*Promising results---A cooperative control project with CA Parks and Recreation.

Nevada County, infested pond not far from Bear River--- seed source to this river.
Pre-Treatment, August 2000

Post Treatment, August 2001

Fall River, Shasta County
A demonstration plot was set-up
Pre-treatment, August 2000

Post treatment at near by site, August 2001
Treatment very successful
Site used as demonstration site for field day.

CONTROL: METHODS LOOK PROMISING


Digging isolated purple loosestrife plants found in the Delta. Purple loosestrife has an extensive root system, all roots must be dug out or re-sprouting will occur the following year.


Spot treatment with Rodeo along Feather River and in White Slough.

CA Fish and Game collecting water samples. Samples were taken at three representative sites in the Delta as a programmatic quality check.

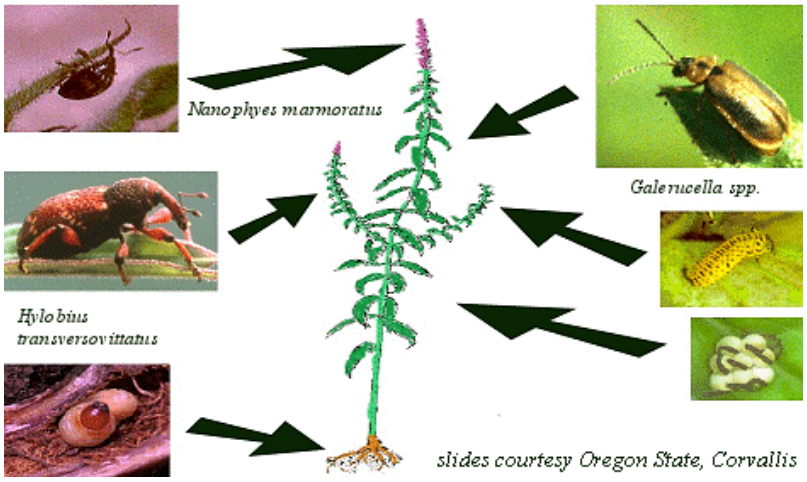
Biological Control Efforts in Butte and Shasta Counties

Promising Agent, a leaf eating beetle, *gallerucela spp.*

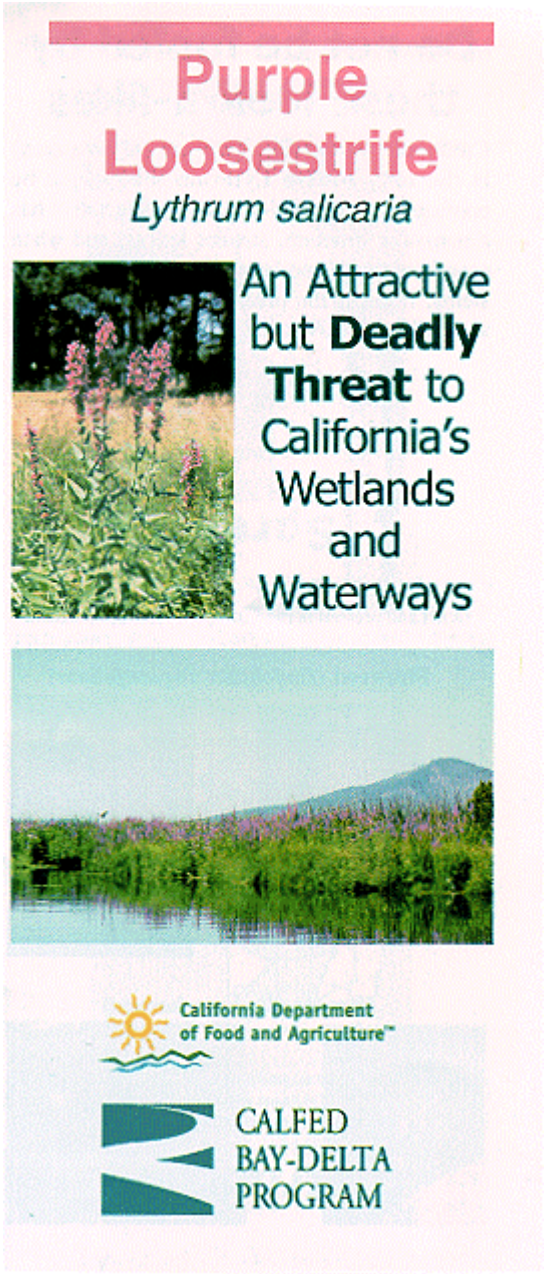
Releases in Butte County.

The beetle skeletonizes leaves and strips stems.

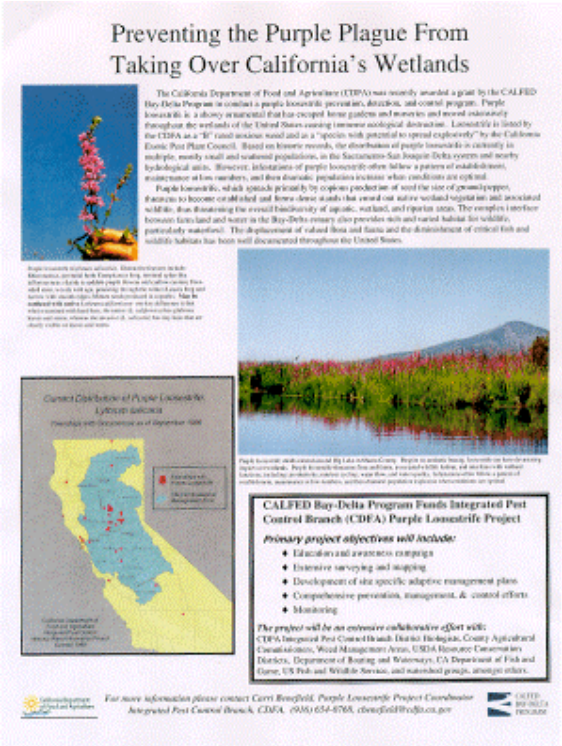
Purple Loosestrife and Introduced Biological Control Agents



Education Outreach: Some Products



Brochure, 16 panels (cover show here) covering identification, history of introduction, distribution, biology, ecology, control methods, alternative plantings, and a report form.



Posters Handout Out to Target Audiences, in addition to brochure.

A sticker distributed at training sessions.