Wetland and Riparian Restoration Management Measure Tracking

Summary Report September 30, 2005

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Introduction and Methods

The purpose of this report is to summarize the existing information on wetland and riparian restoration projects contained in various tracking databases in California. To this end, five tracking databases (listed in Table 1) were obtained, compiled, georeferenced, and summarized. Section 1 of this report contains statewide and regional breakdowns on location, costs, and areas associated with restoration projects.

Although several of the tracking databases contained records for restoration projects from 1980 to the present, the graphs, tables, and maps for this exercise were confined to projects with start dates listed from 1993-2004. This was done to minimize the under-representation earlier restoration activities that were not actively tracked and those initiated in 2005 that have not yet been entered into the databases.

When possible, projects were identified as primarily one of four types; Acquisition, Restoration, Monitoring/Assessment/Planning, and Education/Outreach, by categorical identifiers in the tracking databases and information contained in the detailed project descriptions. The geographic distribution and costs associated with project type are discussed in Section 2. Project goal attainment, trends, and information on projects that contained secondary Monitoring/Assessment/Planning and Education/Outreach components are addressed in Section 3. Methods (and results) addressing Data Quality issues are addressed in section 4 of this report. All reported project areas values were standardized from various units (miles², kilometers², hectares, etc) to acres for reporting purposes. Reported length values were similarly standardized to linear miles.

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Tracking Database	Data supp lier	Period of	Number of Projects	Types of Projects
		nJopal	Total/Since 1993 (% Geo-referenced)	(Listed in order of prevalence)
The Natural Resource Projects Inventory (NRPI)	A Collaborative Effort between the California Biodiversify Council and the Universify of California at Davis Information Center for the Environment.	1980-2004*	1,368 / 1,044 (93%)	Wetland Restoration, Riparian Restoration, Education/Outreach, Monitoring/Assessment/Planning
Wetland Tracker (SFEI)	San Prancisco Estuary Institute	1980 – 2002	144 / 72 (100%)	Wetland Restoration, Acquisition
California Habitat Restoration Project Database (CHRPD)	A cooperative project involving the California Department of Fish and Game, NOAA Fisheries, and the Pacific States Marine Fisheries Commission.	1981- present	1,249 / 902 (100%)	Riparian Restoration, Monitoring/Assessment, Education/Outreach, Acquisition
Parks Projects Database	California Department of Parks and Recreation	1980-present	252 / 140 (58%)	Riparian Restoration, Wetland Restoration, Acquisition
Wildlife Conservation Board (WCB) Project Data	Wildlife Conservation Board	1995-present	949 / 949 (62%)	A cquisition, Riparian Restoration, Wetland Restoration

Table 1. Information from restoration project tracking databases used for summary report.

Distribution of Wetland and Riparian area Projects



Map 1.0 Wetland and riparian area restoration projects (1993-2004) with valid coordinate data in tracking databases.



Map 1.1 The statewide distribution of restoration projects by project cost. More detail can be observed in the following regional maps.



Map 1.2 Distribution of Wetland and Riparian area projects by project size.

Projects reporting greater than 10,000 acres may represent watershed monitoring, assessment, and planning projects rather than on-the-ground restoration projects. This is discussed in section 5 (Data Quality). More detail is available in the following regional maps.

Section 2 – Types of Restoration Projects

One of the goals of this exercise was to examine the characteristics of the different types of restoration projects being conducted in California. Because it was difficult to confirm when projects were duplicated in various tracking databases, most of the analyses summarized in this report were done separately for each database. Although this makes it harder to obtain a clear overview of wetland and riparian area restoration efforts, it does provide more detailed information and offers an opportunity to compare and contrast the types of projects captured in each database.

The proportion of 'project types' and the funding amounts associated with them are shown as a series of pie charts (Figure 2). Two of the largest tracking databases, the Natural Resource Project Inventory (NRPI) and the California Habitat Restoration Project Database (CHRPD) show general agreement in the largest category (restoration) with differing proportions of the remaining 3 types. The Wildlife Conservation Board database differs from the other three in the large number of 'acquisition' projects tracked. This difference is also apparent when comparing funding amounts geographically (Map 2.1). The State Parks project inventory is comprised primarily (~ 90%) of restoration projects. The CHRPD database contained the largest number (and proportion) of projects classified as primarily Monitoring/Assessment.



Figure 2. The proportion of the types of projects in four of the tracking databases.

The overall number of 'restoration' and 'acquisition' projects is shown in figure 2.1. Generally, there was a large amount of variability in the content and distribution of projects for each of the tracking databases. There was some general agreement that there are larger numbers of projects in North Coast, Central Valley, San Francisco Bay, and Central Coast regions.



Figure 2.1 Number of projects by Region (1993 - 2004) by tracking database. Each bar is subdivided into two categories, Restoration projects (Lower and darker section of bar) and Acquisition projects (upper and lighter section of bar).

*SFEI projects are located entirely within Region 2 (San Francisco Bay) **CHRPD projects are located in Regions 1-5.



Because the funding amounts (primarily acquisition) in the WCB database were so much larger than those of the other databases, the number of projects, acres acquired, and project cost from the WCB database was also charted regionally in Map 2.2



Wildlife Conservation Board acquisition data indicates that the largest number of projects was in the Central Valley, the largest areas acquired was in the Central Coast, and the most expensive acquisitions were in the Los Angeles region. Fewer acquisitions were made in the Lahontan, Colorado River, and San Francisco Bay areas.



The costs associated with restoration projects in the NRPI dataset was examined geographically by habitat type. Riparian and non-tidal wetland restoration projects in the Central Valley accounted for the largest amount.

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San Diego



	Active Acatolica						
Regional Board	Wetlands (non-tidal) Wetlands (tidally influenced		Riparian areas				
North Coast	73,680	104,891	150,098				
San Francisco Bay	12,900	142,835	131,395				
Central Coast	35,139	126,953	178,876				
Los Angeles	185	13,306	30,136				
Central Valley	274,794	103,637	520,660				
Lahontan	2,656	7,010	68,263				
Colorado River	1,230	20,000	158				
Santa Ana	40,545	13,000					
San Diego	5	10,046	83				

Map **2.4** Reported acreage restored by habitat type (Source: The Natural Resource Projects Inventory (NRPI), projects containing valid coordinate data and area information for 1993-2004).

The regional breakdown of restoration project area by habitat type (in the NRPI database) is generally similar to that of project cost, except that larger proportions of tidally-influenced wetland areas are recorded in Regions 1-3 (North Coast, San Francisco

Bay, and the Central Coast). Both maps show fewer restoration projects in regions 7-9 (Colorado River, Santa Ana, and San Diego).



	Project Cost (in millions)								
Regional Board	Restoration	Monitoring/ Assessment	Education/ Outreach	Acquisition					
North Coast	104.7	8.1	3.1	0.09					
San Francisco Bay	20.2	13.9	2.4	3.5					
Central Coast	9.5	3.0	2.7	-					
Los Angeles	6.8	9.2	3.6	6.2					
Central Valley	16.5	14.2	4.3	0.8					
Lahontan	-	-	-	-					
Colorado River	-	-	-	-					
Santa Ana	-	0.22	0.06	-					
San Diego	-	0.17	0.11	6.9					



Restoration projects in Region 1 (North Coast) account for the largest funding amounts in the CHRPD database and the largest proportion of funding in other areas. Funding associated with monitoring projects was generally the second largest category for most regions. The CHRPD database does not contain information for any projects in Regions 6 & 7 (Lahontan and Colorado River).

Section 3 – Timeline/Trends and Project Success

Restoration information from each of the tracking databases was examined by year in an attempt to identify basic trends over the last decade. Although it is difficult to determine if trends are related to improved tracking and reporting or real differences in restoration efforts, this exercise represents the first stage of the process. Tabular information on project funding in four of the tracking databases is presented by year in Table 2.

The average funding amount from the NRPI, CHRPD, and State Parks databases is plotted in Figure 3 and the cumulative number of projects (by year) is shown in Figure 4. There appears to be a steady increase in the number of projects in all of the tracking databases, with a slight increase in the rate of additional projects reported (primarily in the WCB database) starting around 1999-2000.

			(1)	(4)	(2)	(2)	(1)	(84)	(156)	(115)	(114)	(02)
WCB			\$8,500	\$665,200	\$251,900	\$215,000	\$1,091,700	\$135,115,600	\$456,434,700	\$241,757,600	\$894,999,400	\$374,400,100
	(24)	6	(12)	6	(10)	(E	(19)	(18)	(11)	(17)	8	(2)
State Parks	\$1,543,700	\$532,000	\$867,000	\$46,500	\$291,700	\$5,700	\$710,000	\$710,000	\$688,500	\$684,000	\$229,000	\$230,100
	(52)	(34)	(23)	(29)	(45)	(64)	(51)	(94)	(153)	(108)	(158)	(85)
CHRPD	\$1,645,400	\$1,933,800	\$765,400	\$1,344,400	\$2,108,100	\$8,046,600	\$9,122,200	\$17,290,200	\$51,331,300	\$19,630,500	\$20,567,300	\$23,415,500
	(35)	(47)	(47)	(49)	(81)	(68)	(09)	(20)	(13)	(65)	(171)	(19)
NRPI	\$1,137,100	\$2,546,900	\$8,517,200	\$19,478,900	\$30,260,500	\$16,802,000	\$56,531,800	\$5,892,400	\$14,255,800	\$26,364,100	\$96,319,200	\$10,234,300
Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004

Table 2. Tabular data of costs associated with restoration projects in tracking databases by year. The number of projects is identified in parenthesis.



Figure 3. Time series of the average annual funding associated with projects in the NRPI, CHRPD and State Parks tracking databases.



Figure 3.1 The cumulative number of projects contained in the five restoration tracking databases.



Figure 3.2 The cumulative (within database) reported acreage for restoration projects by year in the WCB and SFEI databases.

The WCB and SFEI tracking databases have been documenting an annual average of 535 and 650 acres of restoration projects respectively. The figures from the NRPI database are two orders of magnitude greater, with an annual average of 11,000 acres and a total of 133,000 acres of restoration projects for the period examined.

The NRPI, an online, self-reporting database, prompts information suppliers to report if the project goals were attained, and if a final report for the project is available. Two hundred and sixty-nine out of 775 (35%) respondents indicated that a final report on the project was available. Responses on the attainment of project goals are presented in Figure 4. The large number of projects identified as "ongoing" is probably responsible for the large percentage (60%) of undetermined responses.



Figure 4. Project Goal attainment results in the NRPI database.

The percentage of projects (not classed as primarily Monitoring/Assessment) containing a monitoring and/or assessment component within each of the tracking databases is listed below:

Database	Percent of projects with monitoring and/or assessment component
NRPI	17%
WCB	16%
SFEI	10%
CHRPD	8%

Section 4 – Project Tracking and Data quality

Restoration projects were plotted in a GIS when coordinate data were provided (Map 1.) The percentage of projects with valid coordinate ranged from 58% (State Parks) to 100% (CHRPD and SFEI) (Table 1) Because the State Parks Projects database did not contain precise coordinate information for restoration activities, locations were generalized to the center of the park boundaries. Because project locations in the Wetland Tracker database are represented by polygons, these data were similarly generalized to points for map standardization purposes. Projects identifying multiple site locations (SFEI and CHRPD) were aggregated to a unique project identifier to avoid overcounting relevant values when necessary.

Several checks were performed on key variables to identify and remove duplicate records representing the same restoration project from the analyses performed in this report. When duplicate entries were identified, the record containing the most complete information was retained. Fifty-one (3.7% of the total number) records within the NRPI dataset were identified as duplicates and marked for deletion.

In an attempt to identify duplicate projects between tracking databases, a GIS analysis was performed to identify projects located within 250 meters of any project contained in a separate database. The NRPI and CHRPD databases contained the largest number of spatially overlapping projects (Table 4) with 241 (almost 25% of each dataset) sites located within 250 meters of each other. It is difficult to determine if the spatial proximity represents the same project, a different component of a project (monitoring or education/outreach), a different year for the same project location, or an entirely different

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project. Twelve of the 13 "near-by" NRPI and WCB projects were able to be verified as duplicates as the Wildlife Conservation Board was identified as the 'Lead Agency' in the NRPI database.

Database	NRPI	SFEI	CHRPD	State Parks	WCB
NRPI	-	8*	241	1	13*
SFEI	8*	-	2*	0	0
CHRPD	241	2*	-	1	13
State Parks	1	0	1	-	0
WCB	13*	0	13	0	-

Table 4. Potential duplicate representation of projects in multiple databases (* indicates that duplication was confirmed.)

A more detailed examination of duplicated projects was performed in Region 2 (San Francisco Bay). Eight wetland restoration projects were determined to represent the same project in NRPI and SFEI Wetland Tracker databases. Three were duplicated in the NRPI and CHRPD databases, and one project was duplicated in the CHRPD and SFEI tracking databases.

Because the SFEI and NRPI both contain information on the acreage associated with restoration projects, these duplicated records were checked for consistency. The SFEI performs detailed delineations for wetland projects. If the SFEI values are assumed to be the "accepted value", the percent error (for acreage) could be estimated for the NRPI dataset using the standard formula (|TV-EV|/TV*100). For this sub-sample of projects, the reported acreage values ranged from 8.7 to 7,322 (mean=1,590) and the percent error ranged from 0% to 19.4% (average = 5.2%).

Three of the tracking databases contained information on project area (NRPI, SFEI, and WCB). The distribution of acreages reported in these databases was examined and graphed in order to identify trends and potential outliers (Figure 5).



Figure 5. Histogram of reported acreage values from the NRPI, SFEI, and WCB databases. Extreme values from the NRPI dataset are highlighted in yellow.

The SFEI and WCB distributions were similar and roughly approximating a normal distribution, with a larger number of smaller projects represented in the SFEI Wetland Tracker database. About 36% of reported acreage values in the NRPI database

were larger than 10,000 acres. These larger areas appear to represent watershed monitoring, assessment, and planning projects rather than on-the-ground restoration projects and were not included in analyses attempting to quantify "restored areas." The remaining values have a slight trend from larger numbers of smaller projects (.5 - 10 acres) to fewer larger projects.

Although several of the tracking databases differ in the way that restoration

project information is stored, there are a number of elements that should be considered

key features necessary for thorough documentation:

- Information about the purpose of the project
- Category of restoration project, along with a separate field containing more detailed information on the restoration activity
- Habitat type
- Project Start and End date
- o Lead agency, Primary contact information, Funding agency and Funding Amount
- Coordinates (Latitude and Longitude) for project location
- Goal attainment

As mentioned earlier, one of the most difficult challenges to summarizing restoration is identifying duplicate records (within and among tracking databases). One improvement to future efforts tracking restoration projects would be the insertion of a "duplicate record" check during data entry. Because the majority of CHRPD projects are linked to the National Hydrography Dataset (NHD), a digital stream layer, all projects located on the same stream reach (or within a specified distance upstream or downstream) can easily be identified. During data entry, these nearby projects could be called up and verified as separate projects, or related to the new entry as a different component of the project (monitoring or education/outreach), or an extension of the

original project. For projects not linked to a stream reach, spatial proximity could be determined by latitude-longitude entry or a dynamic mapping interface.

Other improvements for future tracking efforts could include increased standardization for categorical values for project type and habitat type, and more detailed information about the allocation of resources for projects with multiple components (i.e., restoration, monitoring, and education/outreach).

For self-reporting databases, range checks could be implemented to prompt users to confirm numeric entries (i.e., acreage, linear distance, or funding amounts) outside of an expected range of values. Appendix A: Regional Distribution of Wetland Projects

Wetland and Riparian area Project Cost

Regional Board 1 North Coast



Regional Board 2 San Francisco Bay



Regional Board 3 Central Coast



Regional Boards 5 & 6 Central Valley and Lahontan





Regional Board 7 Colorado River

Regional Board 8 Santa Ana



Regional Board 9 San Diego



۲ 295 Project Area (in Acres) 0.5 - 10 10 - 1,000 200 1,000 - 10,000 Greater than 10,000 0 Area enlarged ۲ 00

Regional Board 1 North Coast

Regional Board 2 San Francisco Bay



Regional Board 3 Central Coast



Regional Board 4 Los Angeles



Regional Boards 5 & 6 Central Valley and Lahontan



Regional Board 8 Santa Ana





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