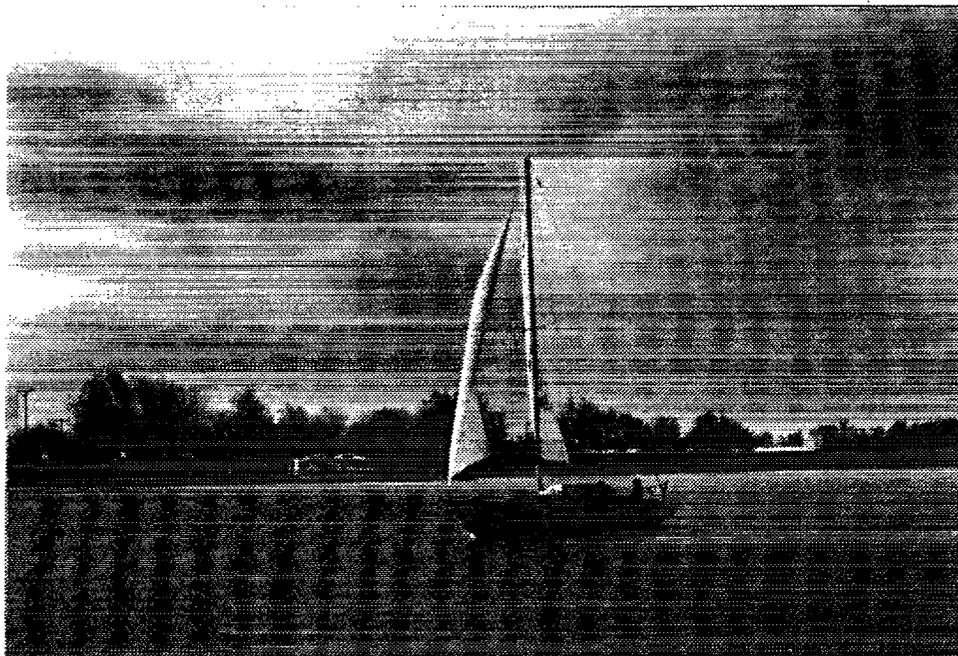


State of California
The Resources Agency
Department of Water Resources
Northern District

North Delta Recreation Use Survey



May 1997

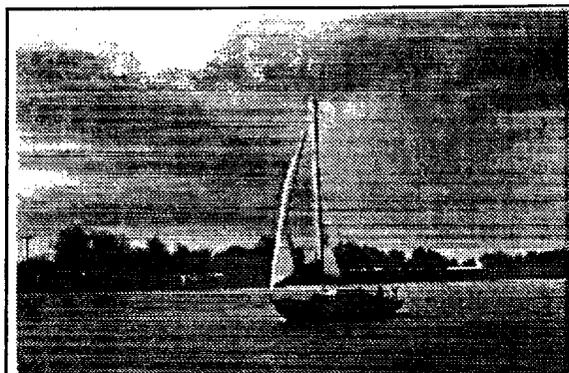
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Department of Water Resources

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C-066704



COVER PHOTO: The most popular Delta recreation activities include the use of watercraft (DWR File Photo).

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North Delta Recreation Use Survey



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FOREWORD

The State's efforts to restore and enhance the resources of the Sacramento-San Joaquin Delta take many forms. Ongoing investigations in the region by the Department of Water Resources and CALFED continue to provide an ever-increasing knowledge base from which to make sound management decisions. In addition to many biological resource investigations and protection measures, the Department also plans for development and enhancement of recreation resources associated with State Water Project facilities.

The rich variety of recreation opportunities found in the Sacramento-San Joaquin Delta attract visitors from all walks of life. The number of such visitors and local recreationists is known to be large, but few efforts have been made to document Delta recreation use on a large scale. This report summarizes the findings of a 1993 DWR survey which encompassed a major portion of this vast area.

The field work was performed as part of the Department's 1993 Interim North Delta Program. It is hoped that compilation and dissemination of these findings will give Delta planners additional valuable information with which to continue recent progress toward finding a balanced solution to water supply and aquatic resource problems in the Delta. This report also provides a modern benchmark from which to evaluate future changes in recreation use, demand, and trends.



Naser J. Bateni, Chief
Northern District

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EXECUTIVE SUMMARY

A survey of recreation use in the Sacramento-San Joaquin Delta, north of Brannan Island State Recreation Area, was conducted in 1993. This survey was made to estimate the amount and types of recreation occurring in the North Delta area for use in SWP and CALFED planning efforts. The stratified random sample survey primarily consisted of roving use counts, but was also supplemented with interviews of accessible recreationists to gather information about recreation use, activities, and visitor origin. The information collected will help the Department meet its obligation, under the Davis-Dolwig Act, to plan for recreation in conjunction with future State Water Project operations in the Delta.

The survey was conducted on 21 dates during April through September. Total recreation use during this 183-day period (excluding use at parks and private marinas) was estimated to total over 1.4 million recreation hours along the North Delta survey route. Based on assumptions regarding low-season use and areas not surveyed, slightly more than three million recreation hours probably occur annually in the North Delta. This represents about 800,000 recreation days, a number much lower than expected based on past estimates.

Waterskiing, general boating, and sailing comprised about 30 percent of total use. Two other major recreation activities were shore fishing and boat fishing, comprising about 24 and 15 percent of all recreation use, respectively.

Most of the individuals contacted for interviews were shore fishermen (93 of 102). Almost all of those interviewed were in the area only for day use (87 of 102). The average length of stay for all day users was 5.7 hours. A plurality of recreationists (39 percent) had travelled from the greater San Francisco Bay Area; other common visitor origins were the rural North Delta area and the greater Sacramento metropolitan area (22 and 21 percent, respectively).

INTRODUCTION

This report represents the most in-depth recreation use survey of the Sacramento-San Joaquin Delta in almost 20 years. It is the first of its kind completed for such a large portion of the Delta. The purpose of this survey was to estimate the amounts and types of recreation use occurring in the North Delta area (Figure 1) to aid SWP and CALFED planning efforts.

In the late 1970s, the Delta Outdoor Recreation Survey (Cajucom et al. 1980) was completed. DORS was a mail survey of visiting recreationists and a door-to-door survey of Delta residents. DORS had several objectives but was not designed to measure the proportion of total use for separate recreation activities. It did, however, estimate Deltawide total recreation use to be about 11.9 million recreation days annually, and predicted that use would grow to 13.6 million recreation days by 1990.

Using a stratified random sampling procedure, the 1993 survey relied on roving use counts along 65 miles of Delta roadways, roughly paralleling an approximately equal length of Delta waterways, in order to gather information about recreation activities and their frequency of occurrence. Use counts were supplemented with recreationist interviews to determine visitor origin and average length of visit. Estimates of use, total and by specific activity, were made for the period April 1 through September 30, 1993. This report describes the recreation use survey and compares the results to those reported in 1980. A list of some potential projects and strategies to enhance public recreational resources in the North Delta, based upon formal and cursory observation, is also included. A subsequent Recreation Reconnaissance Report by DWR's Central District (Recreation Unit) integrated these survey results with an evaluation of recreation enhancement opportunities for consideration during future Delta planning.

DESCRIPTION OF STUDY AREA

The Sacramento-San Joaquin Delta includes over 1,100 square miles around the confluence of the Sacramento and San Joaquin Rivers (Figure 1). Most of the Delta's land area is privately owned, fertile, agricultural land. This includes 57 leveed islands and tracts of various sizes, which are separated by over 700 miles of meandering interconnected waterways.

The surface area of the waterways, mostly rivers and sloughs, totals about 50,000 acres. About 47 percent of California's total runoff passes into the Delta (DWR 1987). The rich aquatic environment supports many fish species, including a portion of the life cycle of about half of the State's anadromous fish resources (Entrix 1992). An abundance of various types of riparian habitat is invaluable to hundreds of species of wildlife, including over a dozen threatened, endangered, or otherwise sensitive species.

These waterways are the centerpiece of what makes the Delta one of California's major outdoor recreation areas. Boating, fishing, hunting, camping, and sightseeing are all uses inspired by the abundant water, fish, wildlife, and cultural resources.

The North Delta Recreation Survey study area is also outlined in Figure 1. The area corresponds to the area of potential hydraulic change identified during what was the Department's 1993 Interim North Delta Program and contains about 215 square miles and 130 miles of waterways (20 and 19 percent of the total Delta, respectively).

METHODS

Recreation Use Counts

Use counts were made in 1993 on randomly selected dates within five survey strata using the optimum allocation method described by Abramson and Tolladay (1959). Twenty-one days of the 183-day period between April 1 and September 30 (these six months traditionally being the preferred recreation season) were surveyed: 4 of 9 holiday weekend dates, 9 of 128 weekdays, and 8 of 46 weekend dates. Holidays were deemed to be a single stratum, weekdays and weekend days were divided into two strata each (an April-June or a July-September stratum).

Recreation use counts were completed twice each survey day while driving a 68-mile course, beginning at 7:30 AM (8:00 AM in April and September) and 2:00 PM. Initially (April 16 and 21) three use counts were done (8:00 AM, 12:00 noon, and 4:00 PM), but this strategy left insufficient time for interviews or delays. A narrative describing the route followed is presented in Appendix A.

The surveys were made from a vehicle or on foot, as necessary, to check access and recreation sites. Recreationists were counted and recorded by recreation activity (Table 1). In cases where unattended vehicles were observed, the surveyor used personal judgment to evaluate the size of the party and if they were likely to be engaged in recreation, based on parking location, vehicle type, and any equipment left in/at the vehicle. When boats were observed, the number of occupants was recorded. An average was calculated (occupants per boat) and applied to boats counted where the occupants were not readily visible.

Each roving survey was assumed to represent the use occurring during a one-hour period, so the average number of recreationists counted per survey on that day was multiplied by factors between 14 and 16 to account for recreation use during all 14 to 16 daylight hours. It should be noted that this procedure generally ignores nighttime recreation (generally fishing or houseboating; camping counts were multiplied by 24 to reflect a full day).

Table 1. Recreation activities included on North Delta survey form.

Motorboating/Waterskiing	Sightseeing
Kayaking/Canoeing	Bicycle Riding
Rafting/Tubing	Motorcycling/OHV Use
Sailing	Horseback Riding
Windsurfing/Boardsailing	Birdwatching
Jet Skiing	Nature Study
Boat Fishing	Photography/Painting
Shore Fishing	Hunting Activities
Swimming/Wading	Just Relaxing
Sunbathing	Camping (undeveloped site)
Walking for Pleasure	Picnicking (picnic area)
Jogging/Running	Picnicking (undeveloped site)
Playing Outdoor Games	Unidentified Recreation/Other
Children Playing	Boats with Unobserved Occupants

We also observed farmers, truck drivers, shoppers, and other residents working along the waterways and roadways in the Delta. We did not include them in the estimates if they were not engaged in obvious recreational activities.

Interviews

Individual recreationists were contacted, as time and opportunity permitted, to collect information based on the size of the group travelling in their vehicle. The city of residence (zip code), number in party, predicted length of stay, and recreation activities planned that day were recorded.

RESULTS

Total recreation use along the 65 miles of route surveyed was estimated to be about 1,420,000 hours (\pm 140,000 hours) during the period April 1 through September 30, 1993. Based on counts of recreationists, waterskiing and general boating was the predominant activity, followed by shore fishing and then boat fishing. No other activities occurred more than seven percent of the time (Table 2, Appendix B). Use counts reflect what recreationists were doing when seen and the number of hours spent on each major activity, but did not provide data on other activities that people pursued at other times during their stay.

Table 2. Recreation hours by activity, North Sacramento-San Joaquin Delta.

<u>ACTIVITY</u>	<u>APR 1-SEP 30, 1993</u>	
	<u>RECREATION HOURS</u>	<u>PERCENT</u>
BOATING, SKIING, SAILING	430,000	30
SHORE FISHING	340,000	24
BOAT FISHING	210,000	15
RELAXING	96,000	7
WALKING AND JOGGING	58,000	4
SWIMMING/WADING, RAFTING/TUBING	57,000	4
INFORMAL/DISPERSED CAMPING	38,000	3
GENERAL PICNICKING	30,000	2
CHILDREN PLAYING	29,000	2
SUNBATHING	25,000	2
HOUSEBOATING	23,000	2
WINDSURFING/BOARDSAILING	16,000	1
JET SKIING	15,000	1
BICYCLE, MOTORCYCLE, OHV USE	17,000	1
OTHER/UNDETERMINED ACTIVITIES	41,000	3

APPROXIMATE HOURS (rounded), ALL ACTIVITIES: 1,420,000

In addition to the use counts, 53 interviews of recreationists were conducted during the 1993 season, representing 102 people. This is a small sample and its statistical usefulness is limited; however, these interviews provided more detailed information on activity participation and additional information on visitor characteristics. About 92 percent of land-based recreationists said they shore-fished during their recreation day.

The most common origin of those engaged in recreation in the North Delta was the greater San Francisco Bay Area (39 percent). A significant percentage came from the rural northern Delta area and the greater Sacramento metropolitan area (22 and 21 percent, respectively). Visitor origin by county groups is illustrated in Figure 2.

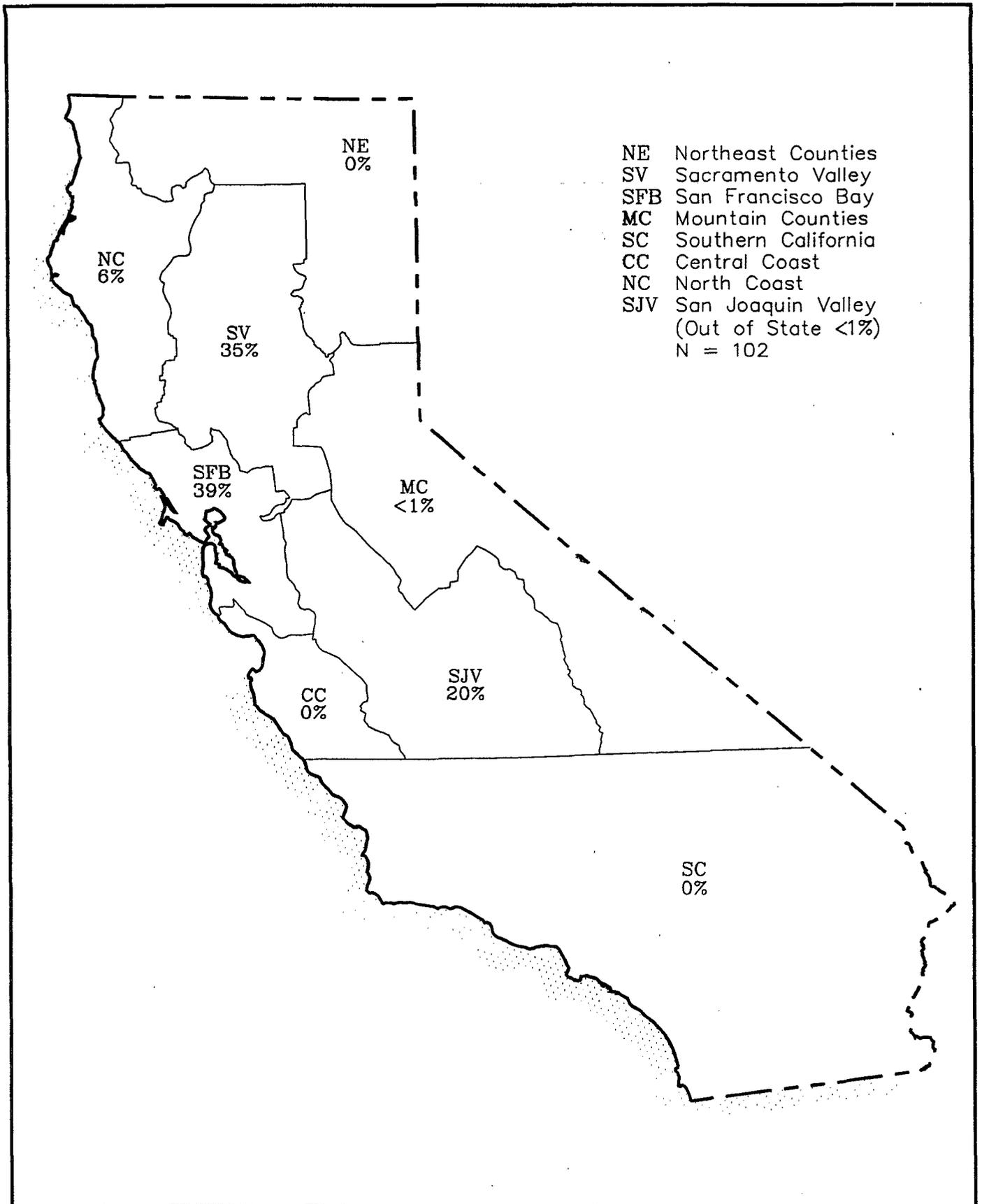


Figure 2 - North Delta Recreationist Origin By County Groups
1993

DISCUSSION

Understanding the limitations of the recreation use survey and recreationist interviews helps put the data obtained in perspective. Most recreationists were readily observed during the use counts. However, accurate counts were difficult in some areas where the water and/or the inside of the levee was not visible from the road. Vehicle access points were checked on each count, but people were not found for some vehicles. Vehicle counts were not utilized in this survey because vehicles of residents, farmers, and other nonrecreationists are often in close proximity to recreation areas. Conversely, the predominance of private property throughout the study area tended to concentrate use in the narrow public right of way and allowed surveyors to make relatively accurate estimates of activity and use over a very large geographic area.

We did not census any of the night recreation (generally fishing and overnight houseboating) which occurs in the Delta. Hinton et al. (1982) reported that considerable fishing for catfish, sturgeon, and shad occurred at night on the lower Sacramento River. A survey of night anglers would help determine the frequency of this activity and if they are contributing primarily to recreation hours (daytime anglers who fish beyond dusk) or additional recreation days (anglers who arrive after the afternoon use counts). Additional discussion of future study design, to help validate the assumptions discussed below, follows in the next section of this report.

Comparison of the findings of this study to DORS (Cajucom et al. 1980) is complicated because of fundamental differences in study area, methodology, and assumptions. Nevertheless, a comparative analysis can be made based on assumptions which increase the 1993 use estimates to reflect a full 12-month period, and proportionally reduce DORS recreation use estimates to reflect the smaller geographic area surveyed in 1993. These assumptions are discussed below.

Several factors must be considered when converting the 1993 survey results to an annual figure, when converting use observed on the survey route to use throughout the North Delta area, and when

converting recreation hours to recreation days. Fishing and a few other activities can be assumed to continue through the winter months, but waterskiing, sunbathing, and many others generally cannot. Given the activity distribution in Table 2, total use counts during the October to March (low-season) period would be expected to be about 60 percent of the use observed during the recreation season. Since daylight hours are fewer during the winter months, the conversion factors for estimated use are about 75 percent of summertime values. Therefore, it is assumed that annual use (in recreation hours) is about 145 percent of the use estimated for April through September, or 2.1 million hours per year. This assumption is supported by the fact that both Brannan Island State Recreation Area and Delta Meadows River Park have reported use temporally distributed in approximately this pattern.

While the study area contains about 130 miles of waterways, only about 67 miles were observable along the survey route. The survey was limited to areas with vehicle access, however, virtually all popular roadway/waterway interfaces were included along the route. Assuming that boating and related use is proportionately distributed along surveyed and unsurveyed waterways, boating-related use in the study area could be double the amount estimated. An additional 650,000 hours of recreation could likely occur on these waterways between April and September, or 950,000 hours annually. Recreation use within the North Delta study area (Figure 1) could reasonably be estimated at over 3 million hours per year.

Conversion of recreation hours to recreation days can only be based upon an analysis of the average length of stay (5.7 hours¹), and assumptions regarding recreationists not counted due to use duration shorter than the time between survey counts. Typically, 6 hours elapsed between counts at any point along the survey route, and 47 percent of those interviewed stayed less than 6 hours. To correct for this higher probability of interviewing people on lengthy visits, a

¹ Although most interviews were conducted with shore-based recreationists, this number is probably reasonable for all activities given the time and effort typically necessary for boat preparation, launching, and operation. The DORS (Cajucom et al. 1980) measured length of stay only in days, not hours. A 4 to 6 hour length of stay was typical for these and other activities during a 1980 survey of the Sacramento River (Hinton et al. 1982).

weighted mean length of stay (harmonic mean) was used to divide the total recreation hours (Lucas 1963). The harmonic mean length of stay was 3.9 hours. Because of the high percentage of day use observed, 3 million recreation hours may reasonably represent about 800,000 recreation days annually in the public areas of the North Delta (excluding parks).

DORS divided the Delta into nine zones plus zone boundary waterways (Figure 3). The North Delta study area contains 29 percent of these boundary waterways, the entirety of Area 4, and portions of Areas 1, 3, 5, and 7 (Table 3). Assuming that use is proportionately distributed by fractional area, just under 25 percent of use calculated in DORS could be expected in the study area (2.88 million recreation days in 1978, 3.29 million in 1990).

While it is beyond the scope of this report to reevaluate the findings of DORS (Cajucom et al. 1980), at least three assumptions therein are surprising, and two may have contributed to an unrealistically high estimate of total recreation use throughout the Delta. According to DORS and based on vehicle counts, 89.5 percent of total recreation use (the fraction contributed by visitors to the Delta) is based on a factor of 5.23 persons per vehicle. This factor is substantially higher than typical values measured at other recreation sites (2.2 to 3.5) and higher than what was usually seen during cursory observation in 1993. The remaining 10.5 percent of use (the fraction contributed by Delta residents) is based on reported per capita recreation use averaging 94.7 days per year. While eight fractional days of simple recreation (walks, etc.) per month is not unlikely, this circumstance may lend to the assumption that a substantial number of recreation experiences may be too short to have been observed during the 1993 survey schedule.

A third and significant assumption results in dismissal of a source of upward bias. DORS made a good effort to clearly identify sources of bias, and most sources of bias were determined to generate

Table 3. Summary of where respondents' groups recreated (Cajucom et al. 1980), and reduction by fractional area included in North Delta Recreation Survey study area.

<u>AREA</u>	<u>PERCENT OF GROUPS</u>	<u>AREA IN NDP (%)</u>	<u>RELATIVE USE (%)</u>
1	0.9	<5	0.1
2	4.2	0	0
3	14.5	70	10.3
4	1.9	100	1.9
5	10.5	25	2.6
6	25.1	0	0
7	7.5	30	2.3
8	7.6	0	0
9	2.8	0	0
Waterways	20.7	29	6.0
Misc.	<u>4.3</u>	≈25	<u>1.0</u>
TOTAL	100		24.2

a slight downward bias; however, no consideration was given to what may have motivated those who did not respond (42.7 percent) to the mail survey. A significant upward bias may have been created by assuming that recreationists were equally represented within respondent and nonrespondent groups. It is not justifiable to assume that since 45.2 percent of respondents recreated in the Delta, an equal proportion of nonrespondents have done so. Recreationists, with a specific experience to relate, are probably inherently more likely to respond to a lengthy survey regarding recreation than those without the recent specific experience.

Several public parks and other controlled areas are within the North Delta study area. Annual visitation reported by the respective managing agency is summarized in Table 4 and is in addition to the 800,000 recreation days estimated for the study area.

Table 4. Annual use at parks and preserves in the North Delta.

<u>SITE</u>	<u>ANNUAL RECREATION DAYS</u>	
Brannan Island SRA	191,500	(1990)
Delta Meadows River Park	18,700*	(1990)
Westgate Landing County Park	17,000*	(1992-93)
Cosumnes River Preserve	4,000	(1992)
Stone Lakes Wildlife Refuge	<u>2,000</u>	(Average)
 TOTAL	 233,200	

* These reports probably significantly understate actual visitation at these sites, because reports are based on fees collected by an honor system, and on patrol reports in an otherwise free access area. Car counters were placed at these sites during the 1993 survey but were not functional for the full duration of the study. A comparative analysis of data from the partial period will be completed at a later date.

In conclusion, the public areas within the North Delta Recreation Survey study area currently support slightly more than 1 million recreation days annually. There are also 37 commercial recreation facilities in this area, patrons of which are undoubtedly among some of those observed during the 1993 study, but which also probably provide many additional tens-of-thousands of recreation days. Although this is less than half of the use that may be inferred from

DORS (Cajucom et al. 1980), there is reason to believe that earlier use may have been overestimated.

These conclusions, and other observations associated with this investigation, have several implications for any future recreation development plans. In the North Delta, public land and public water access is extremely limited. However, we rarely observed any facility or area filled to capacity during 1993, and most private marina operators reported that they never turn away people, cars, or boats. Only on some holiday weekend nights are campgrounds filled to capacity. It would seem that while some types of activities (e.g., hiking and hunting) may be constrained by private property, the greater number of recreationists have ample access to desirable sites. There are opportunities, however, to improve safety, sanitation, and aesthetics at many popular points.

RECOMMENDATIONS FOR FUTURE STUDY

The interpretation of data collected along the survey route, and how it relates to the actual use of recreational resources throughout the North Delta, required a number of assumptions. These assumptions appear reasonable, but they illustrate the realities of staff and budget limitations in studying an area of this size and geographic complexity.

For future investigations in such settings, several procedures could be employed to validate specific assumptions necessary for data expansion:

1. Additional Staff for Use Counts. Additional surveyors, probably Student Assistants, would allow additional counts each survey day. Five counts per day is a good standard, four would probably be most logistically feasible given the route we established. Extra counts, earlier and later in the day, would help validate assumptions about temporal distribution of various recreation activities among daylight hours. Counts of vehicles and boats at night may be the best way to estimate night fishing, to determine the contribution of these activities to overall recreation use.

2. Additional Interviews. Increasing the number of interviews twenty-fold would still sample less than one percent of North Delta recreationists but would allow statistically significant evaluation of recreationist characteristics. Interviews of boat users would be desirable; this would be best accomplished by incorporating a boat survey into the study design and using additional staff to administer interviews. Interviews of anglers at night², where accessible, would establish the proportion that had been included in day use counts.

3. Concurrent Aerial Counts of Recreationists. Aerial use counts should be conducted on several days, concurrently with some ground surveys. This would allow a correction for recreationists not seen from the roadway on other survey dates, and would help validate assumptions about relative distribution of boaters on otherwise inaccessible waterways.

² While nighttime car and boat counts could be conducted safely, individual interviews may not be realistic in dark and remote areas.

POTENTIAL FUTURE RECREATION DEVELOPMENT STRATEGIES AND PROJECTS

Controversy surrounds proposals to develop additional recreational facilities in the Delta. Factors such as competition against existing private facilities, boating safety issues related to the relatively high density of watercraft during busy periods, private property and trespass conflicts, recreationists engaged in depreciative behaviors, the inability of some agencies to properly patrol and maintain existing public facilities, and the impacts of development in sensitive species' habitat are among the many considerations to be included in any future planning. Below are listed some relatively current efforts towards recreation planning in the North Delta.

1. Tower Park Public Launch Ramp (San Joaquin County). San Joaquin County Parks Department has identified this site, near the State Highway 12 bridge at Terminous, as an excellent location for a new public boat-launching facility. This site is in the middle of one of the largest Delta areas not serviced by a public facility. California Department of Transportation right of way and the private marina adjacent to the site pose issues to be considered, but these are probably negotiable. According to San Joaquin County Parks staff, CEQA and other environmental documentation needs to be completed, at an estimated cost of \$60,000. The County does not have the resources to budget for this at the present time.

2. Westgate Landing Facility Expansion. This popular recreation area, originally constructed in 1982, was expanded in 1992. Funding for these facilities has come from the Wildlife Conservation Board, the Department of Boating and Waterways, 1984/86/88 State Bond Funds (Department of Parks and Recreation), and San Joaquin County. Additional expansion is planned (if funding is secured) to add campsites, a second rest room, showers, and 20 additional berths. However, the county reports that water supply may be limiting; the well is only 60 feet deep.

3. Brannan Island SRA General Plan Implementation. The State Parks and Recreation Commission approved the General Plan for Brannan Island in 1987. While some features of the plan have been implemented,

facility expansion and other construction has slowed due to State budget shortfalls and failure of recent park bond initiatives. Nevertheless, the Plan clearly identifies and justifies specific projects designed to improve recreation opportunities and experiences over the next 15 years.

4. Delta Meadows River Park General Plan Development. DPR has a backlog of General Plan assignments to complete. Funding and staff availability are both issues which have slowed the pace of GP preparation. At Delta Meadows, scheduling of the planning process was delayed during efforts to acquire a substantial area adjacent to the unit. Expediting any acquisition, the classification process, and GP development for this unit will help determine the role that Delta Meadows can play in meeting the needs of Delta recreationists.

5. Sacramento County Trails and Bikeways Report Implementation. In 1988, the Sacramento County Open Space Task Force studied undeveloped areas in the county to determine desirable routes for trail corridors. Their report inventoried existing trails and prioritized acquisition for development of proposed trails/corridors. The plan proposes acquiring rights of way and constructing 161 miles of bike trails and 390 miles of hiking/equestrian trails. Potential areas occur at Snodgrass Slough, Stone Lakes, Lost Slough, Cosumnes River, and other areas in the North Delta. Acquisition and development are threatened by the budget crisis facing Sacramento County Department of Parks and Recreation.

6. Stone Lakes Wildlife Refuge Plan Implementation. The U.S. Fish and Wildlife Service has prepared an EIS for the Stone Lakes Wildlife Refuge. The potential of Stone Lakes to meet the needs of Delta recreationists depends upon management alternatives selected by FWS during master plan preparation. Specific actions to benefit recreation will be specified during this uncompleted process.

7. Interpretive Facilities at Cosumnes River Preserve. Acquisitions at this Nature Conservancy site include a building scheduled to serve as a visitor center beginning in fall 1993. Another feature, the Willow Slough Trail, is also open to the public. Interpretive

facilities, trail guides, etc. are planned but not yet available. Development of access and interpretation for passive recreation would increase the relatively low use occurring at the Cosumnes River Preserve.

8. "Delta-Park" Fee Parking Program. Numerous past reports have stated the desirability of establishing a single entity to manage public recreation in the Delta, instead of the current myriad of federal, State, and county agencies. Certainly, there are problems common to all recreation sites which could be addressed best at the regional level. However, the idea of a Deltawide recreation management agency is extremely unpopular among private marina operators, for a variety of reasons. Even under the existing situation, an agency with broad jurisdiction may be able to institute a program similar to California's (DPR) successful "Sno-Park" program. Such a fee parking program for recreationists in public areas would help fund access, sanitary facilities, and safety features for many of the most popular undeveloped sites, and probably increase the rate of fee compliance at existing county facilities.

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APPENDIX A

RECREATION USE COUNT

APPENDIX A

Recreation Use Count

A typical use count began at the east end of the Freeport Bridge on SR 160. Individuals or vessels observed upstream from the bridge were not counted. We proceeded south on SR 160, stopping at an abandoned railroad crossing (Cliff's Marina, unpaved parking area) and numerous wide shoulders and turnouts with overviews of the Sacramento River. Approximately 10 miles south of Freeport our route turned right onto Randall Island Road, followed the levee for about 1.75 miles, and then rejoined SR 160 near Courtland. The levee, river, and public areas along SR 160 in Courtland were included as we followed the highway 1 mile south to the northern intersection of County Route E13 (Courtland Bridge). The route followed E13 along the east levee of the river. At the Delta Cross Channel (Locke), the course turned left and followed a poor road parallelling the Cross Channel for about half a mile. At the end of this side road we turned around, backtracked to E13, and continued south to Walnut Grove. At Walnut Grove we turned right to cross Georgianna Slough, and turned right again to follow Isleton Road along the east levee of the river for about 8 miles. At the Isleton Bridge the east levee again becomes SR 160, and this highway was driven 8.5 miles to the Brannan Island State Recreation Area entrance. Highway frontage areas of Isleton, numerous wide shoulders and turnouts, and the Cliffhouse Day Use Area were observed along this section of the route.

At Brannan Island SRA (not included in the use count), the course backtracked (north SR 160) from the entrance for less than a mile to Brannan Island Road. Brannan Island Road was followed for its entire length, first east along 7 Mile slough and the San Joaquin River, then north along the Mokelumne River to SR 12. At SR 12 the course turned right (west) and then right again (north) onto Terminous Road, which was followed 3 miles back to Isleton. SR 160 was followed north 1 mile from Isleton to Tyler Island Bridge Road, but no counting was done northbound on SR 160 since this section of the levee and river was included in the southbound portion of the course. After crossing Tyler Island Bridge, Tyler Island Road was followed first south

(Georgianna Slough) and then north (North Fork Mokelumne River) along the levees. About 2 miles south of Walnut Grove the road left the levee, from this point Race Track Road was taken to County Route J11 and the Georgianna Slough Bridge crossed earlier at Walnut Grove.

The final stretch of the use count course involved turning left (south) after again crossing the Georgianna Slough Bridge onto Andrus Island Road. Andrus Island Road was followed, along the west levee of Georgianna Slough, for about 2.5 miles to a County Day Use Area. The use count terminated at this parking area; recreationist interviews were then initiated at this and other nearby areas.

In two instances in April, the route was driven in the opposite direction in the afternoon.

APPENDIX B

RECREATION HOURS BY ACTIVITY ON SURVEY DATES

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Recreation Sampling
KEY TO SURVEY DATES
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS
Total days in stratum >	64	24	64	22	9	183
1 : Survey Dates	APRIL 16	MAY 1	JULY 12	JULY 18	MAY 31	
2 :	APRIL 21	MAY 15	JULY 23	AUGUST 1	JULY 5	
3 :	MAY 5	JUNE 13	AUGUST 5	AUGUST 2	SEPT. 4	
4 :	MAY 17	JUNE 27	SEPT. 24	SEPT. 26	SEPT. 6	
5 :	JUNE 9					
6 :						
7 :						
8 :						
9 :						
10 :						

Total Days Sampled	5	4	4	4	4	21

STRATUM 1: WEEKDAYS, APRIL thru JUNE
 STRATUM 2: WEEKEND DAYS, APRIL thru JUNE
 STRATUM 3: WEEKDAYS, JULY thru SEPTEMBER
 STRATUM 4: WEEKEND DAYS, JULY thru SEPTEMBER
 STRATUM 5: HOLIDAY (3-DAY) WEEKEND DATES

Recreation Sampling
ALL RECREATIONAL ACTIVITIES
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1 : Estimated Use per Sample Date (hrs)	6435	18283	4568	19878	12722		
2 :	4410	17417	5446	15434	17723		
3 :	5704	14658	4703	10992	11786		
4 :	4384	12700	4353	10703	15436		
5 :	2088						
6 :							
7 :							
8 :							
9 :							
10 :							

Total Use in Samples	23021	63058	19070	57007	57667	219823	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	4604.20	15764.50	4767.50	14251.75	14416.75	10467.76	HOURS
Total Use in Stratum	294669	378348	305120	313539	129751	1421426	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	1656.7	2561.8	474.7	4331.0	2693.4	70818.9	HOURS
Confidence Interval						138805	HOURS
Percent CI						9.8%	

Recreation Sampling
BOATING, SKIING, SAILING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	330	2499	1300	9884	5066		
Estimated	254	2497	2059	7820	8070		
Use per	396	6376	1464	5184	4372		
Sample	293	5051	1213	5263	7185		
Date (hrs)	524						
6							
7							
8							
9							
10							

Total Use in Samples	1797	16423	6036	28151	24693	77100	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	359.40	4105.75	1509.00	7037.75	6173.25	3671.43	HOURS
Total Use in Stratum	23002	98538	96576	154831	55559	428505	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	105.8	1933.7	381.1	2258.3	1740.9	33698.4	HOURS
Confidence Interval						66049	HOURS
Percent CI						15.4%	

Recreation Sampling
SHORE FISHING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	3045	6144	656	2144	3600		
Estimated	2100	5968	750	1184	2016		
Use per	2304	2048	848	1792	2086		
Sample	2144	1888	798	1610	2604		
Date (hrs)	816						
6							
7							
8							
9							
10							

Total Use in Samples	10409	16048	3052	6730	10306	46545	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	2081.80	4012.00	763.00	1682.50	2576.50	2216.43	HOURS
Total Use in Stratum	133235	96288	48832	37015	23189	338559	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	803.7	2362.2	81.8	399.5	731.0	34432.7	HOURS
Confidence Interval						67488	HOURS
Percent CI						19.9%	

Recreation Sampling
BOAT FISHING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	1995	4520	364	874	992		
Estimated	1081	3888	437	406	1061		
Use per	2260	930	199	1032	902		
Sample	971	385	1226	1250	975		
Date (hrs)	276						
6							
7							
8							
9							
10							

Total Use in Samples	6583	9723	2226	3562	3930	26024	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	1316.60	2430.75	556.50	890.50	982.50	1239.24	HOURS
Total Use in Stratum	84262	58338	35616	19591	8843	206650	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	807.5	2075.7	457.3	357.9	65.3	34970.3	HOURS
Confidence Interval						68542	HOURS
Percent CI						33.2%	

Recreation Sampling
JUST RELAXING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	120	704	288	2064	512		
Estimated	105	896	624	2208	1408		
Use per	128	720	560	624	476		
Sample	256	688	280	812	1526		
Date (hrs)	144						
6							
7							
8							
9							
10							

Total Use in Samples	753	3008	1752	5708	3922	15143	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	150.60	752.00	438.00	1427.00	980.50	721.10	HOURS
Total Use in Stratum	9638	18048	28032	31394	8825	95937	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	60.6	96.9	179.8	824.4	564.0	10284.8	HOURS
Confidence Interval						20158	HOURS
Percent CI						21.0%	

Recreation Sampling
WALKING AND JOGGING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	180	336	256	832	608		
Estimated	90	320	400	416	608		
Use per	64	560	352	528	350		
Sample	128	544	574	280	546		
Date (hrs)	64						
6							
7							
8							
9							
10							

Total Use in Samples	526	1760	1582	2056	2112	8036	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	105.20	440.00	395.50	514.00	528.00	382.67	HOURS
Total Use in Stratum	6733	10560	25312	11308	4752	58665	HOURS
Formula:N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	49.3	129.7	133.2	235.0	122.2	5150.4	HOURS
Confidence Interval						10095	HOURS
Percent CI						17.2%	

Recreation Sampling
SWIMMING/WADING, RAFTING/TUBING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	0	432	320	1296	672		
Estimated	0	288	256	1376	1248		
Use per	64	960	112	480	224		
Sample	32	1280	28	532	448		
Date (hrs)	32						
6							
7							
8							
9							
10							

Total Use in Samples	128	2960	716	3684	2592	10080	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	25.60	740.00	179.00	921.00	648.00	480.00	HOURS
Total Use in Stratum	1638	17760	11456	20262	5832	56948	HOURS
Formula:N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	26.8	461.6	133.0	480.8	439.8	8255.9	HOURS
Confidence Interval						16182	HOURS
Percent CI						28.4%	

Recreation Sampling
 INFORMAL/DISPERSED CAMPING
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	105	192	216	624	216		
Estimated	105	504	216	168	288		
Use per	120	408	144	264	408		
Sample	48	528	192	312	192		
Date (hrs)	72						
6							
7							
8							
9							
10							

Total Use in Samples	450	1632	768	1368	1104	5322	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	90.00	408.00	192.00	342.00	276.00	253.43	HOURS
Total Use in Stratum	5760	9792	12288	7524	2484	37848	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	29.3	153.0	33.9	197.3	97.0	2919.9	HOURS
Confidence Interval						5723	HOURS
Percent CI						15.1%	

Recreation Sampling
 GENERAL PICNICKING
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	15	272	80	416	416		
Estimated	0	320	64	448	944		
Use per	0	800	32	208	392		
Sample	64	880	14	224	546		
Date (hrs)	16						
6							
7							
8							
9							
10							

Total Use in Samples	95	2272	190	1296	2298	6151	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	19.00	568.00	47.50	324.00	574.50	292.90	HOURS
Total Use in Stratum	1216	13632	3040	7128	5171	30187	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	26.3	316.4	29.9	125.6	255.5	3961.2	HOURS
Confidence Interval						7764	HOURS
Percent CI						25.7%	

Recreation Sampling
 SUNBATHING
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	15	208	128	768	16		
Estimated	15	160	80	624	1056		
Use per	0	512	96	272	294		
Sample	16	224	0	14	196		
Date (hrs)	16						
6							
7							
8							
9							
10							

Total Use in Samples	62	1104	304	1678	1562	4710	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	12.40	276.00	76.00	419.50	390.50	224.29	HOURS
Total Use in Stratum	794	6624	4864	9229	3515	25025	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	6.9	159.7	54.5	341.3	458.4	4454.0	HOURS
Confidence Interval						8730	HOURS
Percent CI						34.9%	

Recreation Sampling
 CHILDREN PLAYING
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	120	192	160	368	432	1272	
Estimated	75	400	128	176	352		
Use per	48	816	96	304	294		
Sample	0	304	14	126	532		
Date (hrs)	32						
6							
7							
8							
9							
10							

Total Use in Samples	275	1712	398	974	1610	4969	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	55.00	428.00	99.50	243.50	402.50	236.62	HOURS
Total Use in Stratum	3520	10272	6368	5357	3623	29140	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	45.4	272.3	62.7	111.8	103.2	3947.4	HOURS
Confidence Interval						7737	HOURS
Percent CI						26.6%	

Recreation Sampling
HOUSEBOATING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	165	768	0	0	0		
Estimated	165	576	0	0	0		
Use per	256	0	432	0	294		
Sample	0	0	0	0	0		
Date (hrs)	0						
6							
7							
8							
9							
10							

Total Use in Samples	586	1344	432	0	294	2656	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	117.20	336.00	108.00	0.00	73.50	126.48	HOURS
Total Use in Stratum	7501	8064	6912	0	662	23138	HOURS
Formula:N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	113.3	395.8	216.0	0.0	147.0	8574.4	HOURS
Confidence Interval						16806	HOURS
Percent CI						72.6%	

Recreation Sampling
WINDSURFING/SAILBOARDING
NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	0	16	32	192	0		
Estimated	15	64	304	48	272		
Use per	0	0	240	16	392		
Sample	16	560	0	0	112		
Date (hrs)	0						
6							
7							
8							
9							
10							

Total Use in Samples	31	640	576	256	776	2279	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	6.20	160.00	144.00	64.00	194.00	108.52	HOURS
Total Use in Stratum	397	3840	9216	1408	1746	16607	HOURS
Formula:N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	8.5	268.0	150.7	87.6	172.9	5618.2	HOURS
Confidence Interval						11012	HOURS
Percent CI						66.3%	

Recreation Sampling
 JET SKIING
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	15	96	16	304	112		
Estimated	2	0	160	48	464	288	
Use per	3	32	352	16	176	168	
Sample	4	16	128	14	210	378	
Date (hrs)	5	16					
6							
7							
8							
9							
10							

Total Use in Samples	79	736	94	1154	946	3009	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	15.80	184.00	23.50	288.50	236.50	143.29	HOURS
Total Use in Stratum	1011	4416	1504	6347	2129	15407	HOURS
Formula:N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	11.3	115.0	16.4	128.9	119.5	1935.7	HOURS
Confidence Interval						3794	HOURS
Percent CI						24.6%	

Recreation Sampling
 BICYCLE RIDING
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	0	64	48	96	32		
Estimated	2	30	176	64	80	96	
Use per	3	32	160	112	112	98	
Sample	4	64	192	0	56	112	
Date (hrs)	5	48					
6							
7							
8							
9							
10							

Total Use in Samples	174	592	224	344	338	1672	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	34.80	148.00	56.00	86.00	84.50	79.62	HOURS
Total Use in Stratum	2227	3552	3584	1892	761	12016	HOURS
Formula:N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	23.8	57.5	46.2	23.9	35.7	1715.8	HOURS
Confidence Interval						3363	HOURS
Percent CI						28.0%	

Recreation Sampling
 MOTORCYCLE AND OHV USE
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	15	800	0	0	0		
Estimated	15	32	0	0	0		
Use per	0	0	0	0	14		
Sample	0	0	0	0	0		
Date (hrs)	16						
6							
7							
8							
9							
10							

Total Use in Samples	46	832	0	0	14	892	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	9.20	208.00	0.00	0.00	3.50	42.48	HOURS
Total Use in Stratum	589	4992	0	0	32	5612	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	8.4	395.0	0.0	0.0	7.0	4332.7	HOURS
Confidence Interval						8492	HOURS
Percent CI						151.3%	

Recreation Sampling
 NATURE- & BIRD-WATCHING, PHOTOGRAPHY & ART
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS	
Total days in stratum >	64	24	64	22	9	183	DAYS
1	30	16	0	0	0		
Estimated	15	0	0	16	0		
Use per	0	16	0	0	14		
Sample	16	16	0	14	14		
Date (hrs)	16						
6							
7							
8							
9							
10							

Total Use in Samples	77	48	0	30	28	183	HOURS
Total Days Sampled	5	4	4	4	4	21	DAYS
Avg Use on Sample Days	15.40	12.00	0.00	7.50	7.00	8.71	HOURS
Total Use in Stratum	986	288	0	165	63	1502	HOURS
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3		
Std. Dev. of Stratum:	10.6	8.0	0.0	8.7	8.1	318.0	HOURS
Confidence Interval						623	HOURS
Percent CI						41.5%	

Recreation Sampling
 OTHER OR UNDETERMINED ACTIVITIES
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS
Total days in stratum >	64	24	64	22	9	183
1	285	1024	704	16	48	
Estimated	345	1168	16	0	16	
Use per	0	0	0	0	1008	
Sample	320	32	0	0	70	
Date (hrs)	0					
6						
7						
8						
9						
10						

Total Use in Samples	950	2224	720	16	1142	5052
Total Days Sampled	5	4	4	4	4	21
Avg Use on Sample Days	190.00	556.00	180.00	4.00	285.50	240.57
Total Use in Stratum	12160	13344	11520	88	2570	39682
Formula: N2/n-N	755.2	120.0	960.0	99.0	11.3	
Std. Dev. of Stratum:	174.7	626.4	349.4	8.0	482.2	13783.4
Confidence Interval						27015
Percent CI						68.1%

Recreation Sampling
 KEY TO SURVEY DATES
 NORTH DELTA 1993

Stratum >	1	2	3	4	5	TOTALS
Total days in stratum >	64	24	64	22	9	183
1	APRIL 16	MAY 1	JULY 12	JULY 18	MAY 31	
Survey	2	APRIL 21	MAY 15	JULY 23	AUGUST 1	JULY 5
Dates	3	MAY 5	JUNE 13	AUGUST 5	AUGUST 2	SEPT. 4
4	MAY 17	JUNE 27	SEPT. 24	SEPT. 26	SEPT. 6	
5	JUNE 9					
6						
7						
8						
9						
10						

Total Days Sampled	5	4	4	4	4	21

STRATUM 1: WEEKDAYS, APRIL thru JUNE
 STRATUM 2: WEEKEND DAYS, APRIL thru JUNE
 STRATUM 3: WEEKDAYS, JULY thru SEPTEMBER
 STRATUM 4: WEEKEND DAYS, JULY thru SEPTEMBER
 STRATUM 5: HOLIDAY (3-DAY) WEEKEND DATES

CONVERSION FACTORS

Quantity	To convert from customary unit	To metric unit	Multiply customary unit by	To convert to customary unit, multiply metric unit by
Length	inches (in)	millimeters (mm)*	25.4	0.03937
	inches (in)	centimeters (cm)	2.54	0.3937
	feet (ft)	meters (m)	0.3048	3.2808
	miles (mi)	kilometers (km)	1.6093	0.62139
Area	square inches (in ²)	square millimeters (mm ²)	645.16	0.00155
	square feet (ft ²)	square meters (m ²)	0.092903	10.764
	acres (ac)	hectares (ha)	0.40469	2.4710
	square miles (mi ²)	square kilometers (km ²)	2.590	0.3861
Volume	gallons (gal)	liters (L)	3.7854	0.26417
	million gallons (10 ⁶ gal)	megaliters (ML)	3.7854	0.26417
	cubic feet (ft ³)	cubic meters (m ³)	0.028317	35.315
	cubic yards (yd ³)	cubic meters (m ³)	0.76455	1.308
	acre-feet (ac-ft)	thousand cubic meters (m ³ x 10 ³)	1.2335	0.8107
	acre-feet (ac-ft)	hectare-meters (ha - m) [‡]	0.1234	8.107
	thousand acre-feet (taf)	million cubic meters (m ³ x 10 ⁶)	1.2335	0.8107
	thousand acre-feet (taf)	hectare-meters (ha - m) [‡]	123.35	0.008107
	million acre-feet (maf)	billion cubic meters (m ³ x 10 ⁹) [♦]	1.2335	0.8107
	million acre-feet (maf)	cubic kilometers (km ³)	1.2335	0.8107
Flow	cubic feet per second (ft ³ /s)	cubic meters per second (m ³ /s)	0.028317	35.315
	gallons per minute (gal/min)	liters per minute (L/min)	3.7854	0.26417
	gallons per day (gal/day)	liters per day (L/day)	3.7854	0.26417
	million gallons per day (mgd)	megaliters per day (ML/day)	3.7854	0.26417
	acre-feet per day (ac-ft/day)	thousand cubic meters (m ³ x 10 ³ /day)	1.2335	0.8107
Mass	pounds (lb)	kilograms (kg)	0.45359	2.2046
	tons (short, 2,000 lb)	megagrams (Mg)	0.90718	1.1023
Velocity	feet per second (ft/s)	meters per second (m/s)	0.3048	3.2808
Power	horsepower (hp)	kilowatts (kW)	0.746	1.3405
Pressure	pounds per square inch (psi)	kilopascals (kPa)	6.8948	0.14505
	feet head of water	kilopascals (kPa)	2.989	0.33456
Specific capacity	gallons per minute per foot of drawdown	liters per minute per meter of draw-down	12.419	0.08052
Concentration	parts per million (ppm)	milligrams per liter (mg/L)	1.0	1.0
Electrical conductivity	micromhos per centimeter	microsiemens per centimeter (μS/cm)	1.0	1.0
Temperature	degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32)/1.8	(1.8 x °C) + 32

* When using "dual units," inches are normally converted to millimeters (rather than centimeters).

‡ Not used often in metric countries, but is offered as a conceptual equivalent of customary western U.S. practice (a standard depth of water over a given area of land).

♦ ASTM Manual E380 discourages the use of billion cubic meters since that magnitude is represented by *giga* (a thousand million) in other countries. It is shown here for potential use for quantifying large reservoir volumes (similar to million acre-feet).

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