6.	Suisun Bay off Bull's Head Point near Martinez Samples are collected near the Southern Pacific Railroad bridge at Benicia.	38-02-40	122-07-00
7.	Grizzly Bay at Dolphin near Suisun Slough Samples are collected from a shallow embayment 1.4 miles east of the mouth of Suisun Slough.	38-07-02	122-02-19
8.	Suisun Bay off Middle Point near Nichols Samples are collected in Suisun Bay within the west reach of the Middle Ground Channel.	38-03-36	121-59-20
9.	Honker Bay near Wheeler point The sampling site is located in a shallow embayment 1.9 miles northeasterly from Point Palo Alto.	38-04-26	121-56-12
10.	Sacramento River at Chipps Island Samples are collected west of the confluence of the Sacramento and San Joaquin Rivers between Chipps and Mallard Islands.	38-02-47	121-55-02
11.	Sherman Lake near Antioch Samples are collected 2 miles north of Antioch near the center of a submerged tract between the Sacramento and San Joaquin Rivers.	38-02-34	121-47-34
12.	San Joaquin River at Antioch. Ship Channel Samples are collected 0.3 miles north of Antioch between the entrance markers of the Antioch Reach Channel in the San Joaquin River.	38-01-15	121-48-28
13.	Big Break near Oakley The sampling site is located 1.3 miles north of Oakley in a submerged tract.	38-01-05	121-42-38
14.	San Joaquin River at Jersey Point This sampling site is located on the San Joaquin River 6.5 miles northeast of Antioch in the shipping channel.	38-03-09	121-41-17

6.	Suisun Bay off Bull's Head Point near Martinez Samples are collected near the Southern Pacific Railroad bridge at Benicia.	38-02-40	122-07-00
7.	Grizzly Bay at Dolphin near Suisun Slough Samples are collected from a shallow embayment 1.4 miles east of the mouth of Suisun Slough.	38-07-02	122-02-19
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8.	Suisun Bay off Middle Point near Nichols Samples are collected in Suisun Bay within the west reach of the Middle Ground Channel.	38-03-36	121-59-20
9.	Honker Bay near Wheeler point The sampling site is located in a shallow embayment 1.9 miles northeasterly from Point Palo Alto.	38-04-26	121-56-12
10.	Sacramento River at Chipps Island Samples are collected west of the confluence of the Sacramento and San Joaquin Rivers between Chipps and Mallard Islands.	38-02-47	121-55-02
11.	Sherman Lake near Antioch Samples are collected 2 miles north of Antioch near the center of a submerged tract between the Sacramento and San Joaquin Rivers.	38-02-34	121-47-34
12.	San Joaquin River at Antioch. Ship Channel Samples are collected 0.3 miles north of Antioch between the entrance markers of the Antioch Reach Channel in the San Joaquin River.	38-01-15	121-48-28
13.	Big Break near Oakley The sampling site is located 1.3 miles north of Oakley in a submerged tract.	38-01-05	121-42-38
14.	San Joaquin River at Jersey Point This sampling site is located on the San Joaquin River 6.5 miles northeast of Antioch in the shipping channel.	38-03-09	121-41-17

6.	Suisun Bay off Bull's Head Point near Martinez Samples are collected near the Southern Pacific Railroad bridge at Benicia.	38-02-40	122-07-00
7.	Grizzly Bay at Dolphin near Suisun Slough Samples are collected from a shallow embayment 1.4 miles east of the mouth of Suisun Slough.	38-07-02	122-02-19
8.	Suisun Bay off Middle Point near Nichols Samples are collected in Suisun Bay within the west reach of the Middle Ground Channel.	38-03-36	121-59-20
9.	Honker Bay near Wheeler point The sampling site is located in a shallow embayment 1.9 miles northeasterly from Point Palo Alto.	38-04-26	121-56-12
10.	Sacramento River at Chipps Island Samples are collected west of the confluence of the Sacramento and San Joaquin Rivers between Chipps and Mallard Islands.	38-02-47	121-55-02
11.	Sherman Lake near Antioch Samples are collected 2 miles north of Antioch near the center of a submerged tract between the Sacramento and San Joaquin Rivers.	38-02-34	121-47-34
12.	San Joaquin River at Antioch. Ship Channel Samples are collected 0.3 miles north of Antioch between the entrance markers of the Antioch Reach Channel in the San Joaquin River.	38-01-15	121-48-28
13.	Big Break near Oakley The sampling site is located 1.3 miles north of Oakley in a submerged tract.	38-01-05	121-42-38
14.	San Joaquin River at Jersey Point This sampling site is located on the San Joaquin River 6.5 miles northeast of Antioch in the shipping channel.	38-03-09	121-41-17

6.	Suisun Bay off Bull's Head Point near Martinez Samples are collected near the Southern Pacific Railroad bridge at Benicia.	38-02-40	122-07-00
7.	Grizzly Bay at Dolphin near Suisun Slough Samples are collected from a shallow embayment 1.4 miles east of the mouth of Suisun Slough.	38-07-02	122-02-19
8.	Suisun Bay off Middle Point near Nichols Samples are collected in Suisun Bay within the west reach of the Middle Ground Channel.	38-03-36	121-59-20
9.	Honker Bay near Wheeler point The sampling site is located in a shallow embayment 1.9 miles northeasterly from Point Palo Alto.	38-04-26	121-56-12
10.	Sacramento River at Chipps Island Samples are collected west of the confluence of the Sacramento and San Joaquin Rivers between Chipps and Mallard Islands.	38-02-47	121-55-02
11.	Sherman Lake near Antioch Samples are collected 2 miles north of Antioch near the center of a submerged tract between the Sacramento and San Joaquin Rivers.	38-02-34	121-47-34
12.	San Joaquin River at Antioch. Ship Channel Samples are collected 0.3 miles north of Antioch between the entrance markers of the Antioch Reach Channel in the San Joaquin River.	38-01-15	121-48-28
13.	Big Break near Oakley The sampling site is located 1.3 miles north of Oakley in a submerged tract.	38-01-05	121-42-38
14.	San Joaquin River at Jersey Point This sampling site is located on the San Joaquin River 6.5 miles northeast of Antioch in the shipping channel.	38-03-09	121-41-17

GENERAL INFORMATION AND ABSTRACT

Program:	Regional Effects Monitoring Program: Macroalgae Studies
Funding Agency:	State Water Resources Control Board
Principal Investigator:	Dr. Michael Josselyn (415) 435-1717 Tiburon Center for Environmental Studies (San Francisco State University)
Conducting Agency:	Tiburon Center for Environmental Studies
Period of Record, Earliest Date:	January, 1978
Period of Record, Latest Date:	April, 1988
Geographic Boundaries Description:	Samples are collected throughout the Bay, from Dumbarton Bridge in the South Bay to the Carquinez Strait.

ABSTRACT

The Regional Effects Monitoring (REM) Program is part of the Aquatic Habitat Program run by the Aquatic Habitat Institute and the State Water Resources Control Board. The purpose of the macroalgal component of the REM Program is to monitor long-term changes in the intertidal algal flora and to relate those changes to possible modifications in water quality within San Francisco Bay. Researchers at San Francisco State University were chosen to conduct the macroalgal monitoring program because they had performed similar long term work in the past, as described in Josselyn and West (1985). Establishment of long-term study sites began in November 1986; all sites were in place by February 1987.

Among the preliminary findings of the REM Program is a general decline in species diversity at stations where data from 1981-1983 are available. This appears to be attributable to a decline in the occurrence of brown algae in response to lower salinities during the wet winter of 1985-1986. Percent cover is recorded at each site to allow estimation of biomass. These data indicate a much larger biomass of green algae in the South Bay compared to North Bay, possibly related to higher temperatures or nutrient levels in the South Bay. Range extensions and new appearances of several species have also been documented.

PARAMETERS

BIOLOGICAL PARAMETERS MEASURED
algal biomass
algal cover
species abundance
species composition

CHEMICAL PARAMETERS MEASURED
light transmittance
salinity
water temperature

TAXA
Chlorophyta
Blidingia minima var. minima
Blidingia minima var. subsalsa
Blidingia minima var. vexata
Bryopsis corticulans
Bryopsis hypnoides
Chaetomorpha linum
Codium fragile
Enteromorpha clathrata
Enteromorpha clathrata var. clathrata
Enteromorpha flexuosa
Enteromorpha intestinalis
Enteromorpha linza
Enteromorpha prolifera
Monostroma oxyspermum
Ulothrix pseudoflacca
Ulva augusta
Ulva californica
Ulva fenestrata
Ulva lactuca
Ulva lobata
Ulva penecilliformis
Ulvella setchellii

Phaeophyta
Egregia menziesii
Fucus distichus ssp edentatus
Fucus gardneri
Sargassum muticum

Rhodophyta
Antithamnion dendroideum
Antithamnion kylinii

Antithamnion sp.
Bangia fusco-purpurea
Bangia vermicularis
Ceramium eatonianum
Ceramium gardneri
Ceramium zacae
Cryptopleura violacea
Cryptosiphonia woodii
Erthrocladia irregularis
Gelidium coulteri
Gigartina exasperata
Gracilaria pacifica
Gracilaria verrucosa
Gracilariophila oryzoides
Grateloupia doryphora
Griffithsia furcellata
Gymnogongrus chiton
Gymnogongrus leptophyllus
Gymnogongrus platyphyllus
Gymnothamnion elegans
Halymenia schizymenoides
Hildenbrandia rubra
Hymenena flabelligera
Iridaea cordata
Iridaea cordata var. cordata
Iridaea cordata var. splendens
Mastocarpus jardinii
Mastocarpus papillatus
Microcladia coulteri
Ozophora latifolia
Pikea californica
Platythamnion pectinatum
Platythamnion villosum
Pleonosporium squarrulosum
Polyneura latissima
Polysiphonia decussata
Polysiphonia denudata
Polysiphonia hendryi var. deliquescens
Polysiphonia pacifica
Polysiphonia paniculata
Porphyra lancelata
Porphyra perforata
Pterochondria woodii
Pterosiphonia dendroidea
Pterosiphonia pennata

Chrysophyta

Vaucheria longicaulis

Phylum Unknown
Acrochaetium subimmersum
Antithamionella glandulifera
Ascophyllum nodosum ecad scorpioides
Callithamnion byssoides
Callithamnion pikeanum
Cladophora sericea
Egregia menziesii
Elachista fucicila
Entocladia cingens
Entophyton ramosum
Entocladia viridis
Erythrotricha carnea
Giffordia mitchelliae
Lamnaria sinclarii
Melanosiphon intestinalis
Pelvetiopsis limitata
Pilayella littoralis
Rhizoclonium riparum
Sphaelaria furcigera
Urospora penicelliformis

METHODS

SAMPLING METHODS

Sampling from 1978 to 1983 was conducted primarily in rocky intertidal areas. In order to characterize zonation patterns, sampling locations were selected from the highest elevation of macroalgal growth to the lower limit of extreme low tides. Color slides were taken of quadrats on each sampling date. The slides were then projected onto a grid to allow estimation of percent cover of each species. Species in the photographs were identified with the aid of field notes or collections made at the sampling site. Physical characteristics of adjacent waters that were measured in the field included temperature, salinity, and light extinction.

Similar methods are employed in the REM program. Specimens are collected at each of the study sites, identified, and placed in the herbarium of SFSU. Elevation, type of substratum, and life-history phase are recorded.

SAMPLING FREQUENCY AND LOCATION

Number of Sampling Sites: 18

General collections of macroalgae from 9 locations in San Francisco Bay were made from 1978 to 1983. These locations were:

1) Palo Alto
2) Redwood City
3) Coyote Point
4) Tiburon
5) China Camp
6) Twin Sisters
7) Point Pinole
8) Crockett
9) Martinez

The following 4 sites were sampled in more detail from July 1981 to July 1983:
1) Tiburon
2) Point Pinole
3) Crockett
4) Martinez

The five stations listed below have been sampled monthly since July, 1987:
1) Ravenswood Point
2) Coyote Point
3) Bay Farm Island
4) Point Chauncey (Tiburon Center)
5) Crockett

QUALITY ASSURANCE TESTING AND REPORTING

Specimens are archived at the SFSU herbarium.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Tiburon Center for Environmental Studies
Hardware: IBM compatible
Software: Lotus and dBase
Volume of Data:
Approximately 7,000 records

Quality Assurance:
Data entry is assisted by menus which prompt specific entries and provide some error checking. Additional error checking is performed when various sorting programs are run.

Contact for Data Retrieval

Name: Dr. Michael Josselyn
Tiburon Center for Environmental Studies

San Francisco State University
P.O. Box 855
Tiburon CA 94920
Phone: (415) 435-1717
Access: Publicly available with notice.
Data Availability Date: Immediately

Map information:

Software: Sigmaplot
Subject Description: Percent cover of algal species
Type: Digitized

REFERENCES

Josselyn, M. and N. Philips. 1988. Long-term monitoring program: regional effects element macroalgal component; progress report. Tiburon Center for the Environmental Sciences, Tiburon, CA.

Josselyn, M.N. and J.A. West. 1985. The distribution and temporal dynamics of the estuarine macroalgal community of San Francisco Bay. Hydrobiologia 129: 139-152.

~**Descriptors:** bay-delta; san francisco bay; san pablo bay; central bay; south bay; water quality; biological resources; plankton/algae/seagrass; species diversity; community structure; intertidal; abundance;

GENERAL INFORMATION AND ABSTRACT

Program:	Sacramento-San Joaquin Delta Water Quality Surveillance
Program:	Benthic Studies
Funding Agency:	Department of Water Resources
Principal Investigator:	Harlan Proctor (916) 445-7517 Department of Water Resources
Conducting Agency:	Department of Water Resources
Period of Record, Earliest Date:	January, 1975
Period of Record, Latest Date:	Present
Geographic Boundaries Description:	Five stations in the Western and Central Delta are sampled.

ABSTRACT

Since 1975 the California Department of Water Resources (DWR) has monitored water quality from the Delta through San Pablo Bay. This monitoring is a requirement of Water Right Decision 1485, in which the State Water Resources Control Board establishes conditions for the operation of the State Water Project. [Other aspects of the D1485 monitoring program are described separately in the Estuarine Data Index]. As part of this monitoring program, DWR collects baseline data on benthic community structure in the western Delta. Species occurrence, abundance, and substrate characteristics have been recorded since 1975.

The results of benthic monitoring are summarized annually. Introduced bottom-dwelling invertebrates continued to change the composition of the benthic community in the Delta in 1988. In fact, at least one introduced organism, *Potamocorbula amurensis*, *Corbicula fluminea*, or *Lagunogammarus* sp., was among the four numerically dominant species at each benthic site in 1987 and 1988. All of the exotic organisms appear to have established permanent populations in the Delta and Suisun and San Pablo Bays, with *P. amurensis* becoming the most dominant. Their presence may have disrupted the major mechanisms for change of benthic composition such as physicochemical variations including changes in Delta flows and salinity patterns. They now appear to include biological interactions such as competition and predation. The introduction of exotic organisms has changed the ecological relationships of the Bay and Delta, but the specific impacts of each organism require further study.

PARAMETERS

Media Analyzed: Water. Sediment.

BIOLOGICAL PARAMETERS MEASURED

organism lifestage
organism density
total number of organisms per sample

PHYSICAL PARAMETERS MEASURED

organic matter in sediment
soil classification
sediment grain size

TAXA

Ampelisca milleri
Anisogammarus ramellus
Aulodrilus limnobius
Aulodrilus pluriseta
Balanus improvisus
Barleeia sp.
Boccardia ligerica
Bothrioneurum vejdovskyanum
Branchiura sowerbyi
Bratislavia bilongata
Caenis simulans
Candona sp.
Chaetogaster limnaei
Chironomus attenuatus
Cladotanytarsus sp.
Corbicula fluminea
Corisella inscripta
Corophium acherusicum
Corophium oaklandense
Corophium spinicorne
Corophium stimpsoni
Crangon franciscorum
Cricotopus stimpsoni
Cryptochironomus sp.
Daphnia magna
Daphnia pulex
Demicryptochironomus sp
Dero digitata
Dina parva
Dugesia tigrina
Elasmopus antennatus
Epiococladius sp.
Epischura nevadensis
Eteone lighti

Eudorylaimus sp.
Eurycercus lamellatus
Eurytemora sp.
Forelia sp.
Gemma gemma
Gomphus olivaceus
Gnorimosphaeroma lutea
Grandidierella japonica
Harnischia curtilamellata
Heptagenia rosea
Hexagenia limbata
Hyalella aztecaa
Ilyodrilus frantzi
Ilyodrilus mastix
Ilyodrilus templetone
Lagunogammarus sp.
Latona setifera
Limnodrilius hoffmeisteri
Limnodrilius udekemianus
Lumbriculus variabilis
Lumbriculus variegatus
Limnodrilius angustipenis
Macoma balthica
Manayunkia speciosa
Melita sp.
Mesocyclops edax
Monodiamesa sp.
Musculium sp.
Musculus senhousia
Mya arenaria
Nais communis
Nais pardalis
Nai variabilis
Nanocladius distinctus
Neanthes limnicola
Neanthes succinea
Nitrocra sp.
Oecetis sp.
Ophidonais serpentina
Osphranticum labronectum
Oxyethira sp.
Palaemon macrodactylus
Paracladopema galaptera
Paratendipes sp.
Physella sp.
Polypedilum sp.
Potamocorbula amurensis
Pristina breviseta
Procladius sp.

Prostoma graecense
Psammoryctides californianus
Psectrocladius sp.
Quistadrilus multisetosus
Rhitropanopeus harrissii
Sida cristallina
Simocephalus serrulatus
Simocephalus vetulus
Slavina appendiculata
Spirosperma ferox
Sparganophilus eiseni
Stictochironomus sp.
Stenocypria longicomosa
Streblospio benedicti
Stylaria fossularis
Stylaria lacustris
Synidotea laticauda
Teratocephalus sp.
Unionicola sp.
Vejdovskyella intermedia
Wapsa mobilis
Other organisms as identified

METHODS

SAMPLING METHODS

At two stations situated in channels, 2-3 sites are oriented in a direction perpendicular to the flow of water. At shallow stations one central site is sampled. Three replicates are taken at each site, for a total of 24 benthic samples. A Ponar dredge with a sampling area of 0.053 square meters is used in the collections. Specimens are washed on a 0.595mm mesh screen, and preserved.

Samples of the substrate are also collected at each site with the Ponar dredge. A complete cross section of the substrate is transported to a laboratory for analysis.

SAMPLING FREQUENCY AND LOCATION

Number of Sampling Sites: 5

From 1975 to 1979 sampling was undertaken in the spring and fall at 11 stations. In June of 1980 the number of stations was reduced to the 5 listed below, and sampling is now conducted monthly.

		Latitude	Longitude
1.	Grizzly Bay at Dolphin This sampling station is 1.4 miles east of the mouth of Suisun Slough.	38-07-02	122-02-19

Right bank and center.

2.	Sacramento River at Collinsville Sampled 1.7 miles above the confluence of the Sacramento and San Joaquin Rivers. Right, center and left banks.	38-03-45	121-49-10
3.	Sherman Lake near Antioch The is sampling site is located 2 miles north of Antioch. Right, center and left banks.	38-02-34	121-47-34
4.	Franks Tract Located at the confluence of the False and Old Rivers. Right, center and left banks.	38-02-38	121-36-49
5.	Old River, opposite Rancho del Rio Old River, 0.5 miles upstream from the mouth of Rock Slough. Right and left banks.	37-58-14	121-34-19

ANALYTICAL METHODS

Identification and enumeration of benthic invertebrates are made by a private consultant under contract (Hydrozoology in Newcastle, CA). Organisms are identified to species. Counts and densities are recorded for each species. Laboratory analyses of substrate are performed by the Soils and Concrete Laboratory in Bryte, CA. Gradation analysis of soils is used for quantitative determination of the distribution of particle sizes. Percent organic material is measured for a subsample of each soil sample by a combustion test. Size classes of substrate particles are determined by passing the material through a series of screens.

QUALITY ASSURANCE TESTING AND REPORTING

Three replicate grab samples are taken at each sampled location and are processed individually.

DATA STORAGE AND REFERENCES

DATA STORAGE

Location: Research Triangle Park, South Carolina

Hardware: IBM mainframe

Software: SAS

Volume of Data: Approximately 45,000 lines

Contact for Data Retrieval

Name: Harlan Proctor
3251 S Street
Sacramento CA 95814

Phone: (916) 445-7517

REFERENCES

DWR. 1990. Water quality conditions in the Sacramento-San Joaquin Delta during 1988. Department of Water Resources, Central District. Sacramento, CA.

DWR. 1990. Sacramento-San Joaquin Delta Water Quality Surveillance Program, 1988: Volume III. Department of Water Resources, Central District. Sacramento, CA.

DWR. 1989. Water quality conditions in the Sacramento-San Joaquin Delta during 1987. Department of Water Resources, Central District. Sacramento, CA.

DWR. 1989. Sacramento-San Joaquin Delta Water Quality Surveillance Program, 1987: Volume III. Department of Water Resources, Central District. Sacramento, CA.

DWR. 1988. Water quality conditions in the Sacramento-San Joaquin Delta during 1986. Department of Water Resources, Central District. Sacramento, CA.

DWR. 1988. Sacramento-San Joaquin Delta Water Quality Surveillance Program, 1986: Volume III. Department of Water Resources, Central District. Sacramento, CA.

~**Descriptors:** biological resources; bay-delta; benthic infauna; invertebrates; sediments and dredging; west delta; abundance; community structure; delta outflow; hydrology and flow; clams; shrimp; plankton/algae/seagrass; benthos; Suisun Bay; benthic ecology; grain size; species diversity; shellfish;

GENERAL INFORMATION AND ABSTRACT

Program: Spatial Distribution of *Potamocorbula amurensis* in the Northern Bays and Western Delta

Funding Agency: Department of Water Resources

Principal Investigator: Zach Hymanson

Conducting Agency: Department of Water Resources
US Bureau of Reclamation
State Water Resources Control Board

Period of Record, Earliest Date: August 30, 1990

Period of Record, Latest Date: September 13, 1990

Geographic Boundaries Description: San Pablo and Suisun bays, the major sloughs of Suisun Marsh, and the major channels of the western Delta

ABSTRACT

This study was conducted to determine the current spatial distribution of the Asian bivalve *Potamocorbula amurensis* in the northern Bays and western Delta. Continuing studies by the USGS show that, since this clam was first discovered in late October 1986 in Suisun Bay, it has spread rapidly through the Suisun and San Pablo Bay area, and is having a major effect on benthic and pelagic communities of the northern reach of the bay (Nichols et al. 1990; Schemel et al. 1990). Total abundance and size class distribution estimates will be derived under this program, which will aid in understanding the ecological impacts of *P. amurensis* and will enable investigators to design meaningful laboratory experiments.

PARAMETERS

Media Analyzed: Biota

BIOLOGICAL PARAMETERS MEASURED
total abundance
size class distribution

PHYSICAL PARAMETERS MEASURED
field estimates of substrate composition and gross characteristics:
per cent silt/clay

per cent gravel
per cent organic carbon
per cent sand
per cent shell
texture
odor
color

TAXA
Potamocorbula amurensis

METHODS

SAMPLING METHODS

One sample was collected at each site. A Ponar dredge with a sampling area of 0.053 square meters was used in the collections. Samples were washed over a 0.595 mm mesh screen and the remaining material was preserved.

SAMPLING FREQUENCY AND LOCATION

Number of Sampling Sites: 214

Sample Site Distribution
Sites in channel areas (water bodies less than or equal to 1 km wide) were approximately 1.5 km apart, and site location was alternated between channel center and banks. Sites in non-channel areas (water bodies greater than 1 km wide) were approximately 2 km apart. The column heading below, "Channel Position" refers to the site location in channel areas. "Left" = left bank, "Right" = right bank, and "Center" = center channel.

Locations

Site Number	Latitude/Longitude	Channel Position	Description
	SAN PABLO BAY		
1	37 59.2'/122 25.8'.....		San Quent.
2	37 59.0'/122 24.5'.....		San Quent.
3	38 00.1'/122 27.2'.....		Pet. Pt.
4	38 00.1'/122 25.8'.....		Pet. Pt.
5	38 00.1'/122 24.5'.....		Pet. Pt.
6	38 00.1'/122 24.2'.....		Pet. Pt.
7	38 01.1'/122 28.0'.....		Pet. Pt.
8	38 01.2'/122 27.2'.....		Pet. Pt.
9	38 01.2'/122 25.8'.....		Pet. Pt.
10	38 01.2'/122 24.5'.....		Pet. Pt.

11	38 01.2'/122 23.2'.....	Pet. Pt.
12	38 01.3'/122 21.7'.....	Mare Is.
13	38 01.2'/122 20.3'.....	Mare Is.
14	38 01.2'/122 18.9'.....	Mare Is.
15	38 01.3'/122 17.7'.....	Pet. Pt.
16	38 01.9'/122 28.1'.....	Pet. Pt.
17	38 02.3'/122 27.3'.....	Pet. Pt.
18	38 02.3'/122 25.8'.....	Pet. Pt.
19	38 02.3'/122 24.5'.....	Pet. Pt.
20	38 02.3'/122 23.1'.....	Pet. Pt.
21	38 02.4'/122 21.8'.....	Mare Is.
22	38 02.3'/122 20.5'.....	Mare Is.
23	38 02.3'/122 19.0'.....	Mare Is.
24	38 02.3'/122 17.6'.....	Mare Is.
25	38 02.5'/122 16.2'.....	Mare Is.
26	DELETED	Mare Is.
27	38 03.4'/122 27.2'.....	Mare Is.
28	38 03.4'/122 25.8'.....	Mare Is.
29	38 03.4'/122 24.4'.....	Mare Is.
30	38 03.4'/122 23.1'.....	Mare Is.
31	38 03.4'/122 21.1'.....	Mare Is.
32	38 03.4'/122 20.3'.....	Mare Is.
33	38 03.3'/122 19.0'.....	Mare Is.
34	38 03.3'/122 17.6'.....	Mare Is.
35	38 03.3'/122 16.2'.....	Mare Is.
36	38 04.8'/122 27.1'.....	Pet. Pt.
37	38 04.5'/122 25.8'.....	Pet. Pt.
38	38 04.4'/122 24.4'.....	Pet. Pt.
39	38 04.4'/122 23.1'.....	Pet. Pt.
40	38 04.4'/122 21.7'.....	Mare Is.
41	38 04.4'/122 20.3'.....	Mare Is.
42	38 04.4'/122 19.0'.....	Mare Is.
43	38 05.5'/122 27.2'.....	Pet. Pt.
44	38 05.5'/122 25.8'.....	Pet. Pt.
45	38 05.5'/122 24.4'.....	Pet. Pt.
46	38 05.5'/122 23.1'.....	Pet. Pt.
47	38 05.5'/122 21.7'.....	Mare Is.
48	38 05.5'/122 20.2'.....	Mare Is.
49	38 05.5'/122 19.0'.....	Mare Is.
50	38 06.5'/122 28.6'.....	Pet. Pt.
51	38 06.6'/122 24.4'.....	Pet. Pt.
52	38 06.6'/122 23.0'.....	Pet. Pt.
53	38 06.6'/122 21.8'.....	Mare Is.
54	38 06.6'/122 20.3'.....	Mare Is.
	CARQUINEZ STRAIT	
55	38 03.8'/122 15.0'.....Center	Benecia
56	38 03.4'/122 13.7'.....Left	Benecia
57	38 03.3'/122 12.3'.....Center	Benecia

58	38 03.2'/122 10.8'	.....Right	Benecia
59	38 02.3'/122 10.0'	.....Center	Benecia
60	38 01.5'/122 08.6'	.....Left	Benecia
61	38 02.3'/122 07.5'	.....Center	Benecia
		SUISUN BAY	
62	38 02.3'/122 06.7'	.....	Vine Hill
63	38 03.3'/122 06.6'	.....	Vine Hill
64	38 03.2'/122 05.3'	.....	Vine Hill
65	38 03.6'/122 03.9'	.....	Vine Hill
66	38 03.9'/122 02.6'	.....	Vine Hill
67	38 03.7'/122 01.2'	.....	Vine Hill
68	38 04.3'/122 05.4'	.....	Vine Hill
69	38 04.5'/122 04.2'	.....	Vine Hill
70	38 04.4'/122 01.2'	.....	Vine Hill
71	38 05.4'/122 03.9'	.....	Vine Hill
72	38 05.5'/122 02.6'	.....	Vine Hill
73	38 05.2'/122 00.9'	.....	Vine Hill
74	38 06.2'/122 03.9'	.....	Vine Hill
75	38 06.5'/122 02.5'	.....	Vine Hill
76	38 06.4'/122 01.1'	.....	Vine Hill
77	38 06.6'/122 00.3'	.....	Honker Bay
78	38 07.4'/122 02.5'	.....	Fairfd. So
79	38 07.5'/122 01.1'	.....	Fairfd. So
		SUISUN MARSH	
80	38 07.1'/122 03.8'	.....Center	Vine Hill
81	38 07.5'/122 04.9'	.....Left	Vine Hill
82	38 08.2'/122 04.9'	.....Center	Fairfd. So
83	38 08.6'/122 04.2'	.....Center	Fairfd. So
84	38 09.3'/122 04.3'	.....Right	Fairfd. So
85	38 09.5'/122 03.6'	.....Center	Fairfd. So
86	38 10.1'/122 04.1'	.....Left	Fairfd. So
87	38 10.4'/122 03.4'	.....Center	Fairfd. So
88	38 10.7'/122 03.0'	.....Right	Fairfd. So
89	38 11.2'/122 03.0'	.....Center	Fairfd. So
90	38 11.5'/122 02.4'	.....Left	Fairfd. So
91	38 12.2'/122 02.3'	.....Center	Fairfd. So
92	38 12.6'/122 02.1'	.....Right	Fairfd. So
93	38 13.3'/122 02.0'	.....Center	Fairfd. So
94	38 14.1'/122 02.3'	.....Left	Fairfd. So
95	38 08.0'/122 03.8'	.....Right	Fairfd. So
96	38 08.8'/122 03.4'	.....Center	Fairfd. So
97	38 09.4'/122 02.8'	.....Left	Fairfd. So
98	38 10.2'/122 02.3'	.....Center	Fairfd. So
99	38 10.1'/122 01.4'	.....Right	Fairfd. So
100	38 10.6'/122 00.5'	.....Center	Fairfd. So
101	38 10.8'/121 59.5'	.....Left	Denverton
102	38 11.1'/121 58.8'	.....Center	Denverton
103	38 11.0'/121 57.7'	.....Center	Denverton

104	38 10.3'/121 57.2'	.....Left	Denverton
105	38 10.1'/121 56.5'	.....Center	Denverton
106	38 10.1'/121 55.1'	.....Center	Denverton
107	38 10.6'/121 55.1'	.....Left	Denverton
108	38 10.8'/121 55.0'	.....Center of Bay	Denverton
109	38 11.2'/121 55.5'	.....Center	Denverton
110	38 11.8'/121 55.2'	.....Center	Denverton
111	38 09.8'/121 55.7'	.....Right	Denverton
112	38 09.1'/121 55.1'	.....Center	Denverton
113	38 08.5'/121 54.5'	.....Left	Denverton
114	38 07.9'/121 54.9'	.....Center	Denverton
115	38 07.1'/121 54.3'	.....Right	Honker Bay
116	38 07.1'/121 53.2'	.....Center	Honker Bay
117	38 06.2'/121 53.2'	.....Left	Honker Bay
118	38 05.7'/121 53.3'	.....Center	Honker Bay
119	38 05.1'/121 52.7'	.....Right	Honker Bay
120	38 04.4'/121 52.5'	.....Center	Honker Bay
121	38 04.3'/121 51.7'	.....	Antioch No
		SUISUN BAY	
122	38 05.0'/121 59.6'	.....	Honker Bay
123	38 04.2'/121 59.6'	.....	Honker Bay
124	38 04.2'/121 58.3'	.....	Honker Bay
125	38 04.3'/121 57.0'	.....	Honker Bay
126	38 04.0'/121 55.6'	.....	Honker Bay
127	38 03.1'/121 58.5'	.....	Honker Bay
128	38 03.1'/121 57.0'	.....	Honker Bay
129	38 02.8'/121 55.6'	.....	Honker Bay
130	38 02.4'/121 54.4'	.....	Honker Bay
131	38 03.1'/121 52.9'	.....	Honker Bay
132	38 03.2'/121 52.0'	.....	Antioch No
133	DELETED		
134	38 02.5'/121 53.0'	.....	Honker Bay
135	38 01.9'/121 51.9'	.....Center	Antioch No
136	38 01.6'/121 50.6'	.....Left	Antioch No
137	DELETED		
		SACRAMENTO RIVER	
138	38 03.7'/121 51.0'	.....	Antioch No
139	38 03.9'/121 49.9'	.....Center	Antioch No
140	38 03.5'/121 49.1'	.....Left	Antioch No
141	38 03.6'/121 48.0'	.....Center	Antioch No
142	38 04.1'/121 46.8'	.....Right	Antioch No
143	38 04.4'/121 46.1'	.....Center	Antioch No
144	38 04.5'/121 45.1'	.....Left	Antioch No
145	38 05.1'/121 44.7'	.....Center	Jersey Is.
146	38 05.7'/121 44.0'	.....Right	Jersey Is.
147	38 06.1'/121 43.1'	.....Center	Jersey Is.
148	38 06.5'/121 42.0'	.....Left	Jersey Is.
149	38 07.4'/121 41.7'	.....Center	Jersey Is.

150	38 08.1'/121 41.6'	.....Right	Rio Vista
151	38 08.5'/121 41.2'	.....Center	Rio Vista
152	38 09.1'/121 40.8'	.....Left	Rio Vista
153	38 05.0'/121 44.1'	.....Center	Jersey Is.
		HORSESHOE BEND	
154	38 04.8'/121 43.1'	.....Left	Jersey Is.
155	38 05.4'/121 42.4'	.....Center	Jersey Is.
156	38 06.2'/121 42.4'	.....Right	Jersey Is.
		THREE MILE SLOUGH	
157	38 06.3'/121 41.8'	.....Center	Jersey Is.
158	38 06.7'/121 41.2'	.....Left (West)	Jersey Is.
159	38 06.6'/121 40.9'	.....Center	Jersey Is.
160	38 05.5'/121 41.0'	.....Right (East)	Jersey Is.
		SAN JOAQUIN RIVER	
161	38 02.2'/121 50.3'	.....Center	Antioch No
162	38 02.5'/121 50.5'	.....Left	Antioch No
163	38 01.8'/121 49.6'	.....Center	Antioch No
164	38 01.4'/121 48.8'	.....Right	Antioch No
165	38 01.2'/121 47.6'	.....Center	Antioch No
166	38 01.0'/121 46.7'	.....Left	Antioch No
167	38 01.8'/121 45.9'	.....Right	Antioch No
		SAN JOAQUIN RIVER	
168	38 01.4'/121 44.8'	.....Center	Jersey Is.
169	38 01.4'/121 43.7'	.....Left	Jersey Is.
170	38 02.1'/121 42.8'	.....Center	Jersey Is.
171	38 02.7'/121 42.1'	.....Right	Jersey Is.
172	38 03.2'/121 41.2'	.....Center	Jersey Is.
173	38 03.7'/121 40.5'	.....Left	Jersey Is.
174	38 04.4'/121 40.6'	.....Center	Jersey Is.
175	38 05.4'/121 40.7'	.....Right	Jersey Is.
176	DELETED		
177	38 05.7'/121 39.9'	.....Center	Jersey Is.
178	38 05.3'/121 39.1'	.....Left	Jersey Is.
179	38 05.2'/121 38.1'	.....Center	Jersey Is.
180	38 06.0'/121 37.8'	.....Right	Jersey Is.
181	38 06.1'/121 36.7'	.....Center	Bouldin Is.
182	38 05.9'/121 35.8'	.....Left	Bouldin Is.
183	38 05.8'/121 34.8'	.....Center	Bouldin Is.
184	38 05.1'/121 34.1'	.....Right	Bouldin Is.
185	38 04.4'/121 33.8'	.....Center	Bouldin Is.
		SHERMAN LAKE	
186	38 03.0'/121 47.7'	.....	Antioch No
187	38 02.5'/121 47.6'	.....	Antioch No
		BIG BREAK	
188	38 01.1'/121 44.2'	.....	Jersey Is.
189	38 01.1'/121 42.6'	.....	Jersey Is.
190	38 01.4'/121 41.3'	.....Center	Jersey Is.
191	38 00.8'/121 40.9'	.....Center	Jersey Is.

		FALSE RIVER	
192	38 03.3'/121 39.6'	.....Center	Jersey Is.
193	38 03.2'/121 38.6'	.....Left	Jersey Is.
194	38 02.9'/121 37.7'	.....Center	Jersey Is.
195	38 03.6'/121 37.3'	.....Right	Bouldin Is
196	38 03.5'/121 36.3'	.....Center	Bouldin Is.
197	38 03.7'/121 35.5'	.....Left	Bouldin Is
		FRANKS TRACT	
198	38 02.3'/121 37.3'	.....	Bouldin Is.
199	38 03.0'/121 35.9'	.....	Bouldin Is.
200	38 01.7'/121 35.9'	.....	Bouldin Is.
		OLD RIVER	
201	38 04.3'/121 34.2'	.....Center	Bouldin Is.
202	38 03.8'/121 34.8'	.....Left	Bouldin Is.
203	38 02.9'/121 34.8'	.....Center	Bouldin Is.
204	38 02.4'/121 34.9'	.....Right	Bouldin Is.
205	38 02.2'/121 34.7'	.....Center	Bouldin Is
206	38 02.3'/121 34.2'	.....Left	Bouldin Is.
207	38 01.8'/121 33.8'	.....Center	Bouldin Is.
208	38 01.1'/121 33.3'	.....Right	Bouldin Is.
209	38 01.1'/121 34.1'	.....Center	Bouldin Is.
210	38 00.6'/121 34.1'	.....Left	Bouldin Is.
211	38 00.2'/121 34.6'	.....Left	Bouldin Is.
212	37 59.9'/121 34.1'	.....Right	Woodward Is.
213	37 58.2'/121 34.4'	.....Center	Woodward is.
214	37 57.5'/121 33.8'	.....Left	Woodward Is.
		HOLLAND CUT	
215	38 01.4'/121 34.9'	.....Center	Bouldin Is.
216	38 00.5'/121 34.8'	.....Left	Bouldin Is.
217	37 59.8'/121 34.7'	.....Center	Woodward Is.
218	37 58.9'/121 34.7'	.....Right	Woodward Is.

ANALYTICAL METHODS

Sample analysis at the time of collection was limited to gross estimates of the substrate composition. Photographs of each sample were taken before and after washing. Enumeration and size class distribution of *P.amurensis* will be made by Wayne Fields of Hydrozoology, Inc., Newcastle, CA. All organisms from each sample will be preserved and archived. Analysis results will consist of the summarization of general trends as well as specific trends in size class and spatial distribution within the sample area. A map of the study area will be produced showing sample sites, major substrate types, and the presence or absence of clams at each site.

QUALITY ASSURANCE TESTING AND REPORTING: none

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Department of Water Resources Central District

Hardware: PC
Software: Rbase

Volume of Data: approximately 1 megabyte

Contact for Data Retrieval

Name: Zach Hymanson
Department of Water Resources
3251 S Street
Sacramento CA 95816

Phone: (916) 322-4145

REFERENCES

Carlton, J.T., J.K. Thompson, L.E. Schemel and F.H. Nichols. 1990. Remarkable invasion of San Francisco Bay (California, USA) by the Asian clam *Potamocorbula amurensis*. I. Introduction and dispersal. Mar. Ecol. Prog. Ser. 66: 81-94.

Nichols, F.H., J.K. Thompson and L.E. Schemel. In Press. Remarkable invasion of San Francisco Bay (California, USA) by the Asian clam *Potamocorbula amurensis*. II. Displacement of a former community. Mar. Ecol. Prog. Ser. 66: 95-101.

Schemel, L.E., A.Y. Ota, J.G. Hartmon, J.M. Shay and R.N. Adorador. 1990. Benthic macrofauna and ancillary data from the regional effects monitoring program in San Francisco Bay, California, January to November 1988. USGS Open File Report 89-596.

~**Descriptors:** bay-delta; invertebrates; benthos; biological resources; sediments; community structure; grain size; shellfish; benthic infauna;

GENERAL INFORMATION AND ABSTRACT

Program:	Aerial Surveys of San Francisco Bay Wintering Waterfowl
Funding Agency:	U.S. Fish and Wildlife Service
Principal Investigator:	Jean Takekawa, John Takekawa, or Louise Accurso (415) 792-0222 U.S. Fish and Wildlife Service
Conducting Agency:	U.S. Fish and Wildlife Service
Period of Record, Earliest Date:	December 1986
Period of Record, Latest Date:	Present through 1990
Geographic Boundaries Description:	Surveys are conducted throughout San Francisco Bay, as far north as Suisun, Honker, and Grizzly Bays.

ABSTRACT

The U.S. Fish and Wildlife Service (USFWS) has coordinated annual mid-winter waterfowl surveys of major wintering areas throughout the United States since the mid 1950's (see entry entitled "Pacific Flyway Midwinter Waterfowl Survey"). Recently, personnel from the USFWS San Francisco Bay National Wildlife Refuge, Northern Prarie Wildlife Research Center (NPWRC) and Patuxent Wildlife Research Center (PWRC), both research branches of the USFWS, have increased their survey efforts in order to gain basic ecological data regarding waterfowl use of the Bay during fall and winter. Aerial surveys were conducted monthly from December 1986 through March of 1987. Beginning in October of 1988 survey efforts were doubled by conducting bi-monthly surveys which will continue through April of 1990.

Preliminary findings from monthly aerial surveys conducted between October 1987 and March 1988 indicate that an average of 170,000 ducks were counted in the open water and salt ponds of the Bay (Takekawa *et al.* 1988). Over 80% of these birds were diving ducks. Sex ratios of diving species favored males, but canvasback sex ratios were nearly equal, in sharp contrast to ratios in canvasback populations in the eastern U.S.

Information from these surveys will be used to determine abundance and distribution of waterfowl within the San Francisco Bay ecosystem. These data can be used as a foundation for conducting more specific studies regarding waterfowl use of the Bay, and will also be useful in assessing impacts of future developments within the Bay.

PARAMETERS

BIOLOGICAL PARAMETERS MEASURED

abundance of wintering waterfowl

TAXA

Aix sponsa	wood duck
Anas acuta	northern pintail
Anas americana	widgeon
Anas discors	blue-winged teal
Anas crecca	green-winged teal
Anas cyanoptera	cinnamon teal
Anas clypeata	northern shoveler
Anas platyrhynchos	mallard
Anas strepera	gadwall
Aythya valisineria	canvasback
Aythya americana	redhead
Aythya marila	greater scaup
Aythya affinis	lesser scaup
Branta canadensis	Canada goose
Bucephata clangula	common goldeneye
Bucephala albeola	bufflehead
Fulica americana	American coot
Melanitta fusca	white-winged scoter
Melanitta perspicillata	surf scoter
Melanitta perspicillata	surf scoter
Mergus serrator	red-breasted merganser
Oxyura jamaicensis	ruddy duck

MISCELLANEOUS PARAMETERS MEASURED

percentage of important waterfowl habitat covered
total dabblers
total divers
total ducks
total geese
total swans
miscellaneous waterfowl sighted

METHODS

SAMPLING METHODS

Distribution and abundance of waterfowl are determined by conducting aerial surveys of San Francisco Bay from October through March. All surveys are flown according to a set pattern, and each survey requires two days to complete. An alternate predetermined plan is used in case of conflict with weather, time constraint, or other delay. The airplane is flown at an altitude of 50 m and a speed of 145 km/hour. Three geographic regions are surveyed each day. Most open bay habitat is surveyed by flying 1 km wide transects across the width of the bay.

Two observers record all waterfowl and boats observed within 0.5 km of the plane as transects are flown. Each observer consistently surveys from either the left or right side of the plane for all flights. Observers record species and numbers of waterfowl onto hand-held cassette recorders. Data are later transcribed from these tapes onto data sheets according to species and geographic region.

The North and South Bay salt pond/marsh areas are surveyed by flying a series of short transects in a systematic order to assure coverage of the many irregularly shaped ponds. Observers record species and numbers in each pond or distinct wetland.

SAMPLING FREQUENCY AND LOCATION

Monthly surveys are conducted from planes, boats, and cars from October through March. In 1988 ground surveys were conducted at 42 sites throughout San Francisco and Suisun Bays. In the first year of the study aerial surveys were performed from December 1986 through March 1987. The following year aerial surveys were conducted monthly between October 1987 and March 1988. Surveys were conducted twice monthly October through March and the first week of April for both the 1988/1989 and 1989/1990 seasons. The survey area is broken down into the following six geographical units.

1. South Bay salt ponds - includes salt ponds and marshes south of the San Mateo Bridge.

2. South Bay - includes open bay water south of the San Mateo bridge.

3. Central Bay - includes open bay water north of the San Mateo bridge and south of the Richmond / San Rafael bridge.

4. San Pablo Bay - includes open bay water north of the Richmond / San Rafael bridge and west of the Carquinez Strait.

5. North Bay salt ponds - includes salt ponds and marshes north of Highway 37.

6. Suisun Bay - includes open water east of the Carquinez Strait, and west of the mouth of the San Joaquin - Sacramento Delta.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: San Francisco Bay National Wildlife Refuge

Hardware: hard copy only.

Contact for Data Retrieval

Name: Jean Takekawa
Address: U.S. Fish and Wildlife Service
San Francisco Bay National Wildlife Refuge
P.O. Box 524
Newark CA 94560

Phone: (415) 792-0222

Data Availability Date: Data will be available after publication by Fish and Wildlife Service researchers.

REFERENCES

Takekawa, J. 1987. Status of bird populations in San Francisco Bay-Delta. Presented at Toxic Contaminants and Their Biological Effects in San Francisco Bay-Delta; Berkeley, California, November, 1987.

Takekawa, J.H., D.S. Gilmer, C.M. Marn, H.M. Ohlendorf, L.M. Accurso, and J.E. Takekawa. 1988. Abundance, distribution and habitat use of wintering waterfowl in the San Francisco Bay ecosystem: Preliminary report. Wildlife Research Field Station, Dixon, CA. 42 pages.

~**Descriptors:** bay-delta; suisun bay; san pablo bay; central bay; south bay; san francisco bay; bay-delta; biological resources; birds; waterfowl; abundance; salt ponds; dabbling ducks; diving ducks;

GENERAL INFORMATION AND ABSTRACT

Program: Natural Diversity Data Base

Funding Agency: California Department of Fish and Game

Conducting Agency: California Department of Fish and Game

Period of Record, Earliest Date: 1981

Period of Record, Latest Date: Present

Geographic Boundaries Description: All of the Bay and Delta and the entire state of California are included in this database.

ABSTRACT

The California Department of Fish and Game maintains a statewide inventory of locational information on California's rare and endangered species and natural communities. Established by legislation in 1981, the Database is intended to help identify special species and habitats, and to develop plans to preserve and maintain them. The species inventoried include state and federally listed endangered, threatened, and rare animals and plants, and additionally those considered by the scientific community to be deserving of such status. The inventory is constantly updated, refined, and expanded, allowing it to function as a source of current information.

All documented historic and recent observations of appropriate species are included in the database, which includes over 18,000 locational records on over 1200 species and communities. Each record contains the location, source of information, legal status of the species, and other descriptive information. Sighting information is received continually from agency personnel, consultants, and the public. The Database is stored on a computer system which can generate a variety of products for interested parties. These include data pertaining to particular geographic areas, species, or communities. Map overlays can also be obtained on a variety of scales.

PARAMETERS

MISCELLANEOUS PARAMETERS

Information on rare, endangered, and threatened animals and plants listed by the U.S. FWS and the State of California is compiled.

boundaries of population distribution
county last observed
date last observed
description/comments of site
elevation of the species or community occurrence
general habitat (area, owner protecting)
habitat type
latitude and longitude of site
legal status of the species - ex. endangered, threatened, etc. major information source
ownership/management of site
precision of observation (1/5 mile, 1 mile or 5 mile radius)
site last observed (includes directions to site)
species name - Latin and common
township-range-section where species or community was observed
USGS quadrangle number and name

METHODS

A methods section is not applicable to this database.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Hardware:	Hewlett-Packard Workstations
Software:	Genamap/Oracle
Volume of Data:	Over 18,000 locational records on over 1,200 species and biotic communities.
Quality Assurance:	Data are reviewed independent of entry. Experts are consulted to review the information, which is received from a variety of outside individuals.

Contact for Data Retrieval

Name:	Karen Fleming

Address: California Department of Fish and Game
Natural Diversity Data Base
1416 Ninth Street
Sacramento CA 95814

Phone: (916) 324-3812

Contacts for interpretive information:

Darlene McGriff - animals
(916) 322-2494

Roxanne Bittman - plants
(916) 323-8970

John Ellison - aquatic communities
(916) 322-2495

Robert Holland - plant communities
(916) 324-6857

Thomas Lupo - geography
(916) 445-6264

Map information

Subject Description: Location and distribution of species and communities.

Level of detail: Maps are available in an 8 1/2 x 11 format and also as overlays. The 8 1/2 x 11 maps are produced at the following scales: 1:62,000 on USGS 7 1/2'quadrangle reduced to a 15' scale, and 1:5,000,000, which shows the entire state. Map overlays are available at the following scales: 1:24,000 on 7 1/2' USGS quadrangles; 1:62,500 on a 15' USGS quadrangle; and 1:100,000 at 1/2 Degree latitude x 1 degree longitude. Custom overlays can also be produced.

Type: Maps are produced as overlays designed to register over a base map.

Fees for data retrieval: Sliding scale based on number of records retrieved.

Subscription services are also available for interested agencies and organizations.

Access: Species occurrence and other natural resource information is generally available to the public except for instances where disclosure of the precise location of a rare or endangered species might place it in jeopardy due to its value to unauthorized collectors.

REFERENCES

"The California Natural Diversity Data Base". Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814. 16 pages.

Data base species lists: special animals. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814.

Data base species lists: special plants. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814.

Classification of natural communities: terrestrial section. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814. 9 pages.

A revised classification of natural communities: aquatic section. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814. 30 pages.

List of endangered and threatened animals of California. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814.

List of endangered and threatened plants of California. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814.

California native species field survey form. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814.

Guidelines for assessing effects of proposed developments of rare and endangered plants and plant communities. Available from the Department of Fish and Game, 1416 9th Street, Sacramento, CA, 95814.

~Descriptors: endangered species; biological resources; community structure; bay-delta; san francisco bay; delta; rare species; threatened species; abundance; species diversity; mammals; birds; invertebrates; wildlife;

GENERAL INFORMATION AND ABSTRACT

Program: Pacific Flyway Midwinter Waterfowl Survey

Funding Agency: U.S. Fish and Wildlife Service

Conducting Agency: U.S. Fish and Wildlife Service

Period of Record, Earliest Date: 1955

Period of Record, Latest Date: Present

Geographic Boundaries Description: This study includes the 11 states which form part of the Pacific Flyway, and surveys all important migratory bird habitat in California.

ABSTRACT

The US Fish and Wildlife Service Office of Migratory Bird Management in Portland, Oregon coordinates a midwinter survey of waterfowl abundance in 11 states that are part of the Pacific Flyway. The survey is performed largely by staff of the Fish and Wildlife Service and state fish and wildlife agencies during the first week of January each year. The data allow statewide comparisons of abundance, and assessment of trends since 1956.

In 1987 about 3.6 million ducks were counted, which was the lowest population index since 1955. The greatest loss in numbers of ducks was in California, where the 1987 index of 2 million ducks was 19% that of 1986 and over 50% below the average since 1956. A particularly sharp decline for the Flyway was observed for wintering pintails. The 1987 index of 663,000 pintails was well below 1.3 million in 1986, and 2.3 million for the average since 1956. Indices for diving ducks were also down 41% from the 1986 index.

PARAMETERS

BIOLOGICAL PARAMETERS MEASURED
waterfowl species abundance

TAXA

Anas strepera	gadwall

Anas acuta	pintail
Chen caerulescens	blue goose
Anas discors	blue-winged teal
Branta nigricans	black brant
Bucephala albeola	bufflehead
	cackling Canada goose
Branta canadensis	Canada goose
Aythya valisneria	canvasback
Anas cyanoptera	cinnamon teal
Fulica americana	american coot
Bucephala clangula	common goldeneye
Bucephala islandica	Barrow's goldeneye
Anas platyrhynchos	green-winged teal
	lesser Canada goose
Anas platyrhynchos	mallard
Mergus serrator	red breasted merganser
Aythya americana	redhead
Aythya collaris	ringneck
Oxyura jamaicensis	ruddy duck
Grus canadensis	sandhill cranes
Aythya marila	greater scaup
Aythya affinis	lesser scaup
Melanitta perspicillata	surf scoter
Melanitta deglandi	white winged scoter
Spatula clypeata	northern shoveler
Cygnus columbianus	tundra swans
	whistling duck
Anser albifrons	white-fronted goose
Mareca americana	american wigeon
Aix sponsa	wood duck

METHODS

SAMPLING METHODS

The midwinter survey is performed primarily by personnel of the US Fish and Wildlife Service and state fish and wildlife agencies. Traditionally the survey is conducted during the first week in January. In 1987 while most important areas were surveyed during January 5-22, the overall span was from December 31 to January 22. An effort is made to survey most of the important waterfowl habitat.

DATA STORAGE INFORMATION AND REFERENCES

6.	Suisun Bay off Bull's Head Point near Martinez Samples are collected near the Southern Pacific Railroad bridge at Benicia.	38-02-40	122-07-00
7.	Grizzly Bay at Dolphin near Suisun Slough Samples are collected from a shallow embayment 1.4 miles east of the mouth of Suisun Slough.	38-07-02	122-02-19
8.	Suisun Bay off Middle Point near Nichols Samples are collected in Suisun Bay within the west reach of the Middle Ground Channel.	38-03-36	121-59-20
9.	Honker Bay near Wheeler point The sampling site is located in a shallow embayment 1.9 miles northeasterly from Point Palo Alto.	38-04-26	121-56-12
10.	Sacramento River at Chipps Island Samples are collected west of the confluence of the Sacramento and San Joaquin Rivers between Chipps and Mallard Islands.	38-02-47	121-55-02
11.	Sherman Lake near Antioch Samples are collected 2 miles north of Antioch near the center of a submerged tract between the Sacramento and San Joaquin Rivers.	38-02-34	121-47-34
12.	San Joaquin River at Antioch. Ship Channel Samples are collected 0.3 miles north of Antioch between the entrance markers of the Antioch Reach Channel in the San Joaquin River.	38-01-15	121-48-28
13.	Big Break near Oakley The sampling site is located 1.3 miles north of Oakley in a submerged tract.	38-01-05	121-42-38
14.	San Joaquin River at Jersey Point This sampling site is located on the San Joaquin River 6.5 miles northeast of Antioch in the shipping channel.	38-03-09	121-41-17

GENERAL INFORMATION AND ABSTRACT

Program:	Delta Outflow/San Francisco Bay Study
Funding Agency:	California Department of Fish and Game
Principal Investigator:	Perry Herrgesell Department of Fish and Game (209) 466-4421
Conducting Agency:	Department of Fish and Game
Period of Record, Earliest Date:	January, 1980
Period of Record, Latest Date:	*Present*
Geographic Boundaries:	The study area is bounded on the upstream end by the Highway 120 Bridge on the San Joaquin River at Antioch and Sherman Island on the Sacramento River and on the downstream end by the Golden Gate Bridge. The study area encompasses all of San Francisco Bay, including Honker, Suisun, San Pablo, Central, and South Bays.

ABSTRACT

Since 1980 the California Department of Fish and Game has conducted sampling in San Francisco Bay designed to examine the relationship between freshwater flow to the Bay and abundance and distribution of fish and invertebrates. This effort, part of the Interagency Ecological Studies Program, is the first spatially and temporally comprehensive fishery study to be carried out in the Bay. Monthly sampling of approximately 70 stations throughout the Bay has resulted in a sizable database. More than 1.25 million records are already on STORET (EPA's data storage system), and the program is ongoing.

DFG presented an analysis of these data in an exhibit submitted to the State Water Resources Control Board for the Bay- Delta Water Rights Hearings (DFG 1987). The report describes some findings regarding the most abundant or important species that were collected as they relate to freshwater outflow from the Delta. Results are presented for selected invertebrates, shrimp, crabs, and five groups of fish (true smelts, pelagic fish, sculpins, gobies, and flatfish).

Results are summarized here for a few of the taxa which were subjects of this comprehensive investigation. Euphasiids (or krill) were one of the groups of

invertebrates collected in plankton net tows. Yearly abundance of euphasiid larvae was positively correlated to yearly Delta outflow. This may be explained by greater outflow causing a higher rate of exchange of these organisms through the Golden Gate, or alternatively by the effects of El Nino.

Fourteen species of true shrimp were collected. The most common of these was *Crangon franciscorum*, which comprised almost 90% of the total shrimp catch. Annual abundance of *C. franciscorum* and annual abundance of all sizes of this species are strongly correlated to outflow from March-May. The amount of suitable habitat available for *C. franciscorum* in the Bay is directly related to Delta outflow and the resulting salinity regime. During low outflow years shrimp were more abundant in Suisun Bay than San Pablo Bay. San Pablo Bay has about three times the area of Suisun Bay, and this shift could have a negative effect on the growth and survival of *C. franciscorum*.

Four species of cancrid crabs were collected, the most abundant of these was the Dungeness crab (*Cancer magister*). A negative relationship was observed between outflow and juvenile crab abundance. A strong positive correlation was found between the May-December ringnet catch and the January-March ocean upwelling index. One potential explanation is that the estuarine plume may carry larvae too far offshore during years with high outflow. Another possible explanation is that offshore currents during years with strong winter storms do not allow the organisms to return to the nursery area.

From 1980 through 1985, 137 taxa of fish, representing 122 species were collected. The otter trawl collected 144,385 individuals, representing 85 species; the midwater trawl collected 620,645 individuals, representing 72 species; the beach seine collected 124,482 individuals, and 66 species; and the egg and larval net collected 752,224 individuals, representing 62 taxa. The correlations between Delta outflow and population trends of several fish species, including longfin smelt (*Spirinchus thaleichthys*), northern anchovy (*Engraulis mordax*), pacific herring (*Clupea harengas*), jacksmelt (*Atherinopsis californiensis*), topsmelt (*Atherinops affinis*), sculpins (nine species of *Cottidae*), yellowfin goby (*Acanthogobius flavimanus*), bay goby (*Lepidogobius lepidus*), arrow goby (*Clevelandia ios*), California tonguefish (*Symphurus atricauda*), English sole (*Parophrys vetulus*), speckled sanddab (*Citharichthys stigmaeus*), and starry flounder (*Platichthys stellatus*) are presented.

PARAMETERS

Parameters on which data is stored in STORET by the Delta Outflow/San Francisco Bay Study

BIOLOGICAL PARAMETERS MEASURED
fish length
fish catch

male, female and juvenile shrimp catch
male, female and juvenile shrimp length
male, female and juvenile shrimp stomach fullness
presence of parasite *Argiea* sp. on male, female and juvenile shrimp
maturity or stage of eggs on gravid shrimp
male, female and juvenile crab catch
male, female and juvenile crab length (carapace width)

PHYSICAL PARAMETERS MEASURED
tidal stage
weather
secchi depth (water transparency)
water depth
water temperature
electrical conductivity

Other Parameters

starting latitude of tow
starting longitude of tow
ending latitude of tow
ending longitude of tow
distance of tow (nm)
flow meter revolutions
bearing of tow
direction of tow in relation to current
time of day tow was made
date
station
survey number
tow number
seine length
seine width
subsample

TAXA

Acanthogobius flavimanus	yellowfin goby
Acipensar medirostris	green sturgeon
Acipensar transmontanus	white sturgeon
Agonidae	poachers
Alosa sapidissima	American shad
Allosmerus elongatus	whitebait smelt
Alopias vulpinus	*Thresher shark*
Alosa sapidissima (Wilson)	*American shad*
Alphidae	*unidentified Alphidae*

Ammodytes hexapterus	Pacific sandlance
Amphistichus argenteus	barred surfperch
Amphistichus koelzi	calico surfperch
Apodichthys flavidus	penpoint gunnel
Argentina sialis	Pacific argentine
Artedius harringtoni	scalyhead sculpin
Artedius notospilotus	sculpin
Atherinops affinis	topsmelt
Atherinopsis californiensis	jacksmelt
Bathylagus pacificus	Pacific blacksmelt
Betasus longidactylus	visored shrimp
Beteaus harrimani (Rathbun)	northern hooded shrimp
Beteaus sp.	unidentified Beteaus
Blepharidoda occidentalis	spiny sand crab
Brosomophycis marginata	red brotula
Callianassa californiensis	bay ghost shrimp
Callianassa spp	unidentified Callianassa
Cancer antennarius	brown rock crab
Cancer anthoyi	yellow crab
Cancer gracilis	slender crab
Cancer magister	Dungeness crab
Cancer oregonensis	Oregon cancer crab
Cancer productus	red rock crab
Cancer sp.	Cancer sp. A
Cancer spp.	unidentified Cancer
Cancer spp.	Cancer antennarius/gracilis
Carassius auratus	goldfish
Catostomus occidentalis	Sacramento sucker
Cebidichthys violaceus	monkeyface prickleback
Centrarchidae	sunfish
Chilara tayolri	spotted cusk-eel
Citharichthys sordidus	Pacific sanddab
Citharicytyhys spp.	*unidentified Citharicytyhys*
Citharichthys stigmaeus	speckled sanddab
Clevandia ios	arrow goby
Clinadae	*unidentified Clinids*
Clupeidae	*unidentified Clupeidae*
Clupea harengus palasi	Pacific herring
Cololabis saira	Pacific saury
Coryphopterus nicholsii	blackeye goby
Cottus asper	prickly sculpin
Crangon franciscorum	Bay shrimp
Crangon nigricauda	black-tailed shrimp
Crangon nigromaculata	*blackspotted bay shrimp*
Crangon sp.	*Crangon sp. 3*

Crangon sp.	*Crangon sp. 4*
Crangon sp.	*Crangon francis-nigrica*
Crangon sp.	*unidentified Crangon*
Cyclopteridae	snailfishes
Cymatogaster aggregata	shiner perch
Cyprinidae	carps and minnows
Cyprinus carpio	common carp
Dorosoma petenense	threadfin shad
Embiotoca jacksoni	black perch
Emerita analoga	sand crab
Engraulis mordax	northern anchovy
Euphausia spp.	Euphausia (furcilia)
Euphausia spp.	*Euphausia (juvenile)*
Euphausia spp.	*Euphausia (calyptopis)*
Gadidae	codfishes
Gambusia affinis	mosquitofish
Gasterosteus aculeatus	threespine stickleback
Genyonemus lineatas	white croaker
Gibbonsia metzi	striped kelpfish
Gillichthys mirabilis	longjaw mudsucker
Gobiesox maeanadricus	northern clingfish
Gobidae	*unidentified Gobies*
Hemigrapsus oregonensis	shore crab
Hemilepidotus hemilepidotus	red Irish lord
Hemilepidotus spinosus	brown Irish lord
Heptacarpus brevirostris	stout coastal shrimp
Heptacarpus cristatus	
Heptacarpus palpator	intertidal coastal shrimp
Heptacapus pictus	redbanded clear shrimp
Heptacarpus taylori	Taylor coastal shrimp
Heptacarpus sp.	unidentified Heptacarpus
Hexagrammos decagrammus	kelp greenling
Hippolytidae	*unidentified Hippolytidae*
Hyperprosopon anale	spotfin surfperch
Hyperprosopon argenteum	walleye surfperch
Hyperprosoon ellipticum	silver surfperch
Hypomesus nipponensis	wakasagi
Hypomesus pretiosus	surf smelt
Hypomesus transpacificus	delta smelt
Hypsoblennius gilberti	rockpool blenny
Hypsopsetta guttulata	diamond turbot
Hypsurus caryi	rainbow surfperch
Hysterocarpus traski	tule perch
Icichthys lockingtoni	medusafish
Ictalurus catus	white catfish

Ictalurus melas	black bullhead
Ictalurus nebulosus	brown bullhead
Ictalurus punctatus	channel catfish
Ilypnus gilberti	cheekspot goby
Lampetra ayresi	river lamprey
Lampetra tridentata	Pacific lamprey
Lavinia exilicauda	hitch
Lepidogobius lepidus	bay goby
Lepomis macrochirus	bluegill
Leptocottus armatus	Pacific staghorn sculpin
Liparis pulchllus	showy snailfish
Lissocrangon stylirostris	smooth shrimp
Lophopanopeus bellus	blackclaw crestleg crab
Lucania parva	rainwater killifish
Lysmata californica	red rock shrimp
Majidae	*Majidae*
Medialuna californiensis	halfmoon
Menidia beryllina	inland silverside
Merluccius productus	Pacific hake
Mesocrangon munitella	*miniature spinyhead*
Microgadus proximus	Pacific tomcod
Micrometrus minimus	dwarf perch
Micropterus salmoides	largemouth bass
Mola mola	ocean sunfish
Morone saxatilis	striped bass
Mugil cephalus	striped mullet
Mustelus henlei	brown smoothhound
Myloibatis californica	bat ray
Nematoscelis difficilis	
Neoclinus uninotatus	onespot fringehead
Notemigonus crysoleucas	golden shiner
Nytiphanes simplex	
Odontopyxis trispinosa	pygmy poacher
Oligocottus maculosus	tidepool sculpin
Oligocottus snyderi	fluffy sculpin
Oncorhynchus kisutch	coho salmon
Oncorhynchus tshawytscha	chinook salmon
Ophiodon elongatus	lingcod
order Decapoda	*unknown caridean*
order Decapoda	*Brachyuran*
order Decapoda	*Caridean sp. A*
Orthodon microlepidotus	Sacramento blackfish
Osmeridae	smelts
Oxyjulis californica	senorita
Oxylebius pictus	painted greenling

Pachycheles rudis	porcelain crab
Pachygrapsus crassipes	*striped shore crab*
Paleomon crassipes	lined shore crab
Paleomon macrodactylus	oriental shrimp
Pandalus danae	coon-striped shrimp
Pandalus gurnayi	*California longbeak*
Paralichthys californicus	California halibut
Parophrys vetulus	English sole
Peprilus simillimus	Pacific pompano
Percina macrolepida	bigscale logperch
Phanerodon furcatus	white seaperch
Pholis ornata	saddleback gunnel
Platichthys stellatus	starry flounder
Pleuronectidae (righteye flounders)	*unidentified flounders*
Pleuronichthys coenosus	C-O sole
Pleuronichthys decurrens	curlfin sole
Pleuronichthys verticalis	hornyhead turbot
Pogonichthys macrolepidotus	splittail
Pogonichthys macrolepidotus	splittail
Pomoxis annularis	white crappie
Porichthys notatus	plainfin midshipman
Portumas xantusii santusii	swimming crab
Psettichthys melanostictus	sand sole
Ptychocheilus grandis	Sacramento squawfish
Pugettia producta	northern kelp crab
Pyromaia tuberculata	tuberculate pear crab
Raja binoculata	big skate
Rathbunella hypoplecta	smooth ronquil
Rhacochilus toxotes	rubberlip seaperch
Rhacochilus vacca	pile perch
Rhithropanopeus harrisii	mud crab
Sagitta euneritica	
Salmo gairdneri	rainbow trout
Sardinops sagax caeruleus	Pacific sardine
Scomber japonicus	chub mackerel
Scorpaenichthys marmoratus	cabezon
Sebastes auriculatus	brown rockfish
Sebastes flavidus	*yellowtail rockfish*
Sebastes melanops	black rockfish
Sebastes mystinus	*blue rockfish*
Sebastes spp.	*unidentifies rockfish*
Seriphus politus	queenfish
Spirunchus starksi	night smelt
Spirinchus thaleichthys	longfin smelt
Sphyraena argentea	Pacific barrucuda

Squalus acanthias	spiny dogfish
Stenobrachius leucopsarus	northern lampfish
Stichaeidae	pricklebacks
Symphurus atricauda	California tonguefish
Syngnathus leptorhynchus	bay pipefish
Synodus lucioceps	California lizardfish
Tarletonbeania crenularis	blue lanternfish
Thysanoessa gregaria	
Torpedo californica	Pacific electric ray
Triakis semifasciata	leopard shark
Tridentiger trigonocephalus	chameleon goby
unidentified Atherinidae	
unidentified Osteichtyyes	
Upogebia pugettensis	mud shrimp
Xanthidae	*unidentified Xanthidae*
Xiphister spp.	pricklebacks

METHODS

SAMPLING METHODS

The methods presented here are those described by DFG (1987).

Monthly samples were collected from 35 open water boat sites, 27 inshore seine sites, and 9 pier ringnet sites. At each open water site a tow was made with a midwater trawl, an otter trawl, and an egg and larval net. The midwater trawl has a mouth opening of 3.6m X 3.6m and a 1.3cm stretched mesh codend. It was towed and retrieved for 12 minutes in a manner that sampled all depths an equal amount of time. The otter trawl has 4.5m head rope and the codend is 1.3cm stretched mesh. It was towed for 5 minutes on the bottom and then retrieved at full speed. The egg and larval net is a 505um mesh plankton net with a mouth opening of 0.38 square meters. It is attached to a sled such that it is suspended 12cm above the bottom. It is towed on the bottom for 5 minutes and then retrieved at 9.1m/minute. The distance towed over the bottom was determined with a Loran C. A temperature and electrical conductivity profile of the water column was taken at each sample site, except in 1980 when only surface measurements were taken.

At each inshore site, one or two beach seine hauls were made with a 3 mm delta mesh 15.2m X 1.2m beach seine. All collections were made on flood tide. Surface temperature and electrical conductivity were measured and the area swept by the seine was recorded.

At each pier station, four 1m diameter ringnets with 3.8cm stretch mesh net were set for one 30 minute period. Each station was sampled as near as possible

to slack tide. Temperature and electrical conductivity were measured at about 1m from the bottom.

SAMPLING FREQUENCY AND LOCATION

Number of Sampling Sites: Approximately 70 sites are sampled.

Monthly samples were collected from 35 open water boat stations from January of 1980 through November of 1987; at 42 open-water stations from December of 1987 to the present; at 27 inshore seine sites from August 1980 through January 1987; and at 9 pier ringnet sites from May of 1982 to the present.

1. San Francisco Bay 1.5 km S of Yerba Buena Island
2. South San Francisco Bay near Hunters Point
3. South San Francisco Bay channel near Point San Bruno
4. South San Francisco Bay channel near San Mateo
5. South San Francisco Bay channel near Redwood Creek
6. Central San Francisco Bay at Yerba Buena Island
7. West Suisun Bay near the reserve fleet anchorage
8. North Suisun Bay near the reserve fleet anchorage
9. Grizzly Bay near Suisun Slough channel
10. Grizzly Bay near Simmons Island
11. Honker Bay (center)
12. San Francisco Bay 2.5 km north of Treasure Island
13. San Francisco Bay 3.5 km west of Berkeley Harbor
14. South San Francisco Bay off Oakland Airport
15. South San Francisco Bay near San Leandro Channel
16. South San Francisco Bay near San Mateo-Hayward Bridge
17. South San Francisco Bay near Candlestick Point
18. South San Francisco Bay off Coyote Point
19. San Pablo Bay near the Petaluma River channel entrance
20. San Pablo Bay north of the Pinole Shoal Channel
21. San Pablo Bay near Point San Pedro
22. San Pablo Bay 1.5 km west of Lone Tree Point
23. San Pablo Bay at Black Point, Petaluma River
24. San Francisco Bay near Harding Rock
25. San Francisco Bay 1.5 km east of Angel Island
26. San Francisco Bay 1.5 km north of Angel Island
27. San Francisco Bay near Red Rock
28. San Pablo Bay 2 km NE of Point San Pablo at edge of channel
29. San Pablo Bay channel 2 km NW of Pinole Point
30. West Delta, Benicia Point, Carquinez Strait
31. West Delta, Carquinez Strait SE of Port Costa
32. Sacramento River near Benicia
33. Sacramento River channel in west Suisun Bay

34. Sacramento River near Port Chicago
35. Sacramento River near Chipps Island
36. Sacramento River near Sherman Island
37. West Delta, Sherman Island, Sacramento River
38. West Delta, Antioch, San Joaquin River
39. San Joaquin River near West Island
40. Central San Francisco Bay, Berkeley
41. Central San Francisco Bay, Berkeley Marina
42. Central San Francisco Bay, Keller Beach, Richmond
43. San Pablo Bay, Point Molate
44. San Pablo Bay, McNears Beach
45. San Pablo Bay, China Camp
46. San Pablo Bay, northern mud_flats
47. Central San Francisco Bay, north Golden Gate Bridge
48. Central Bay, North Richardson Bay
49. Central Bay, east Tiburon Peninsula
50. Central San Francisco Bay, Point San Quentin
51. South Bay, Alameda
52. South Bay, East San Mateo Bridge
53. South Bay, Dumbarton Point
54. San Pablo Bay, Point Pinole (West)
55. San Pablo Bay, Point Pinole (East)
56. San Pablo Bay, Crockett-Carquinez Strait Bridge, South
57. Central Bay, South Golden Gate Bridge
58. South Bay, Hunter's Point
59. South Bay, Candlestick Point
60. South Bay, Point San Bruno
61. South Bay, Coyote Point
62. South Bay, West San Mateo Bridge

ANALYTICAL METHODS

Fish and crabs large enough to be easily identified were measured and released; all other fish, crab, and shrimp were taken to the laboratory for processing. Adult, juvenile, and larval fish, shrimp, and crabs were identified to the lowest possible taxonomic level and measured.

QUALITY ASSURANCE TESTING AND REPORTING

Samples processed in the laboratory were subjected to a quality control check to determine if sample sorting and identification were acceptable.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Teale Data Center

Hardware: IBM mainframe

Software: NOMAD

Contact for Data Retrieval

Chuck Armor
California Department of Fish and Game
4001 Wilson Way
Stockton CA 95205
(209) 466-4421

OR

Location: DFG, Stockton

Hardware: IBM AT microcomputer

Software: dBase IV

Volume of Data: 20 megabytes

Contact for Data Retrieval

Chuck Armor
California Department of Fish and Game
4001 Wilson Way
Stockton CA 95205
(209) 466-4421

OR

Location: Research Triangle Park, North Carolina
Hardware: IBM mainframe

Software: STORET

Storet Agency Code: 21CAL-84

Volume of Data: More than 1.25 million records

Contact for Data Retrieval

Phil Daniels
State Water Resources Control Board
(916) 322-4514

REFERENCES

DFG. 1987. "Delta outflow effects on the abundance and distribution of San Francisco Bay fish and invertebrates, 1980- 1985." DFG Exhibit #60 submitted in the State Hearings, available from the Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA, 95205.

~**Descriptors:** fisheries; bay-delta; plankton; delta outflow; delta inflow; biological resources; plankton/algae/seagrass; hydrology and flow; reproduction; species diversity; central bay; abundance; community structure; crabs; south bay;

GENERAL INFORMATION AND ABSTRACT

Program:	Interagency Salmon Study
Funding Agencies:	U.S. Bureau of Reclamation Department of Water Resources Department of Fish and Game U.S. Fish and Wildlife Service
Principal Investigator:	Patricia Brandes U.S. Fish and Wildlife Service (209) 466-4421
Conducting Agency:	U.S. Fish and Wildlife Service
Study Cost:	approximately $150,000 per year
Period of Record, Earliest Date:	1978
Period of Record, Latest Date:	Present
Geographic Boundaries Description:	Samples are collected from Central San Francisco Bay, San Pablo Bay, the Sacramento River from Honker Bay to Colusa, and some Central and South Delta sites.

ABSTRACT

One facet of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary is a study of the population dynamics of the chinook salmon (*Oncorhynchus tshawytscha*), also known as king salmon, the largest of five species of salmon native to the Pacific Coast of North America. Chinook use the Bay and Delta as a nursery and for juvenile and adult migration between the ocean and freshwater habitat. The US Fish and Wildlife Service has primary responsibility for carrying out this research. The Interagency Salmon Study has the overall objectives of monitoring the annual abundance of juvenile salmon; determining the effects of the water projects on the importance of the estuary as a nursing area; and determining the impacts of the water projects on young salmon migrating through the estuary. The study was initiated in 1978 in response to concern over the impacts of the proposed Peripheral Canal. After California voters rejected the Peripheral Canal in 1982, the focus shifted to assessing the impacts of through-Delta water conveyance on the survival of young chinook salmon.

Some of the findings of this research are briefly summarized here, excerpted from an exhibit submitted by the USFWS at the Bay-Delta Hearings (USFWS 1987). Rough estimates of the number of fall-run (accounting for over 90% of all spawners) smolts leaving the Delta from 1978 to 1986 ranged from about 10 to 50 million fish.

These figures translate to about 200,000 to 1,000,000 adults entering the ocean fishery. Abundance of smolts at Chipps Island is apparently related to Sacramento River flow at Rio Vista. The survival of marked hatchery smolts through the northern Delta between Sacramento and Suisun Bay is positively correlated to flow and negatively correlated to both temperature and the percent of flow diverted from the Sacramento River. Typical conditions in the southern Delta are considered detrimental to smolt survival. These conditions include low inflows from the San Joaquin River (the effect of which is accentuated by diversions exceeding river flow during smolt migration periods) and high water temperatures (usually 70 degrees F in May).

Fall run chinook fry rear both upstream and in the estuary with peak abundances seen in the Delta in February and March. As Delta inflow increases, fry become both more numerous and more widely distributed in the estuary. Survival of tagged fry was greater in the upper Sacramento River than the Delta and San Francisco Bay, and better in the northern Delta than in the Central Delta.

On the whole, evidence presented by USFWS suggests that habitat alterations in the Delta limit salmon production primarily through reduced survival during the outmigrant (smolt) stage. These lower survival rates are associated with decreases in the magnitude of flow through the estuary, increases in water temperatures, and water project diversions in the Delta.

PARAMETERS

BIOLOGICAL PARAMETERS MEASURED

fry abundance
smolt abundance
recovery of tagged adults
recovery of tagged fry
recovery of tagged smolts

PHYSICAL PARAMETERS MEASURED

tidal stage

OTHER PARAMETERS MEASURED

electrical conductivity (some but not all years)
water temperature
water transparency

TAXA

Oncorhynchus tshawytscha Chinook salmon

Incidental catch are measured, counted and recorded on data sheets.

METHODS

SAMPLING METHODS

Annual juvenile salmon abundance indices are developed for both the fry and smolt stages. Because fry and smolt behave differently (i.e., fry tend to congregate near shore, and smolts are generally found in open waters), the sampling methods for the two life stages differ.

The fry (defined as 30 to 70 mm fish) are sampled by beach seines (0.25 inch mesh) from January through April at about 40 sites from Colusa through San Francisco Bay. Sampling sites are located in a diversity of locations (boat launch ramps, sand beaches, etc.). These sites are sampled in a consistent manner covering about 50 to 100 feet of shoreline. One seine haul is made at each site per sampling day. The index of fry abundance is simply the number of salmon per seine haul.

Smolts are sampled by a midwater trawl (3.2 mm mesh net) at a standardized speed and depth from April through June at Chipps Island. The trawl fishes approximately the upper one half of the water column where over 90% of the smolts are found during daylight. Ten tows are taken each sampling day. Tows are generally made against the current and distributed across the channel with 3 or 4 tows per day made on the north, middle, and south portion of the channel. The smolt abundance index is the average number of salmon per 20 minute tow.

SAMPLING FREQUENCY AND LOCATION

Number of Stations: Approximately 50 stations total have been sampled. Beach seining usually occurs from January 1 through April 30, although some data have been collected during other months. Sampling is conducted once a week for the north Delta and interior Delta stations, and every two weeks for the lower Sacramento River stations (from Sacramento to Colusa). Samples were collected either every two weeks or once a month from San Francisco Bay sites until 1986.

Trawl samples are usually collected from April through June at Chipps Island. In some years trawls were also undertaken at Clarksburg, Sacramento, Montezuma Slough and the Golden Gate Bridge.

		Latitude	Longitude
1.	Honker Cut boat ramp on the E bank of Honker Cut at King Island Marina between White Slough and Disappointment Slough. Sampled since 1979.	38-03-25	121-27-30

2.	Delta Cross Channel Beach on the north bank about 900 yards from junction with the Sacramento River. Sampled since 1976.	38-14-42	121-30-00
3.	Treasure Island Beach 200 yards S of the yacht harbor. Sampled since 1980.	37-48-52	122-22-07
4.	American River 150 yards from the Sac. River junction. Sampled since 1977.	38-36-20	121-30-15
5.	Middle River - Woodward Island Beach 200 yds north of Woodward Island Ferry.	37-55-43	121-31-38
6.	Mokelumne River 1200 yards downstream of the confluence of the N and S forks, and about 100 yds N of Hwy 12. (B&W resort). Sampled since 1979.	38-07-40	121-34-45
7.	Old River on the beach below the Hwy 4 bridge about 2 miles S or N of Victoria Canal. Sampled since 1976, except for 1978. Sample site moved down the levy road (about 100 yds) near an old house in 1986.	37-53-22	121-34-10
8.	Petaluma River mouth at Black Point boat ramp under Hwy 37 bridge. Sampled in 1980 and 1981.	38-06-50	122-30-15
9.	Carquinez Strait at Brickyard Beach Sampled since 1980.	38-02-00	122-10-10
10.	Sacramento River - Chipps Island Suisun Bay off S bank of Chipps Isl. Sampled since 1975.	38-02-45	121-55-10
11.	Sacramento River E of Montezuma Slough on the Sac R, 1 mile W of Collinsville. Sampled in 1980 and 1981.	38-04-20	121-51-30
12.	Sacramento River at the Sherman Island public fishing access. 2 1/2 miles S of the mouth of Horsehoe Bend. Sampled since 1976.	38-03-37	121-47-07
13.	Sacramento River Stump Beach 1 1/2 miles downstream from Rio Vista Bridge	38-08-02	121-41-10

on Hwy 160. Sampled since 1976.

14.	Sacramento River 1 1/2 miles upstream from the Rio Vista Bridge just N of Dutra Dredge Co. on Hwy 81. Sampled since 1976.	38-10-17	121-40-30
15.	Sac River at Isleton Public boat ramp Sampled since 1976.	38-09-47	121-36-42
16.	Sacramento R beach at Koket Resort 800 yards upstream from Ryde. Sampled since 1976.	38-14-23	121-33-15
17.	Sacramento River at the Clarksburg public fishing access on South River Road, about 2,100 yards upstream from Hood. Sampled since 1976.	38-22-58	121-31-10
18.	Sacramento River at Clarksburg Sampled since 1975.	38-25-25	121-31-40
19.	Sacramento River boat ramp at Garcia Garcia Bend Park about 400 yards upstream from Freeport Bend. Sampled since 1976.	38-30-12	121-33-25
20.	Sacramento River 100 yards from the American River in Discovery Park. Sampled since 1977.	38-36-05	121-30-30
21.	Elkhorn County Park Boat Ramp under I-5. Sampled since 1981.	38-40-33	121-37-30
22.	Verona Resort Boat Ramp at the mouth of the Feather River. Sampled since 1981.	37-47-00	121-37-00
23.	Knights Landing County Park Boat Rmp Sampled since 1981.	38-48-03	121-43-20
24.	Reels Bar, N of Knights Landing Sampled since 1981.	38-51-09	121-43-42
25.	Sacramento River on the beach about 5 miles downstream from Meridian. Sampled since 1981.	39-07-24	121-54-55

26.	Sacramento River at Ward's Resort boat Ramp about 4.2 miles downstream from Colusa. Sampled since 1981.	39-11-04	121-56-08
27.	Sacramento River at Colusa State Recreation Area Boat Ramp. Sampled since 1981.	39-13-12	122-00-48
28.	San Joaquin River at Antioch Dunes National Refuge. 1 1/2 miles from the Antioch Bridge. Sampled since 1979.	38-01-05	121-46-06
29.	San Joaquin River at Sherman's Island 1000 yds S of where 3 Mile Slough ends. In 1982, station changed to Eddo's Boat Ramp. Sampled since 1979.	38-04-40	121-40-55
30.	San Joaquin River SE corner of Venice Island. Just west of Little Connection Slough. Sampled since 1979.	38-03-13	121-30-30
31.	San Joaquin River swimming beach at Louis Park, 1 1/4 miles S of the Calaveras River. Sampled since 1979.	37-57-20	121-20-45
32.	Mokelumne River South Fork at Wimpy's Resort on Walnut Grove- Thornton Road. 100 yds S from jct with the N fork Mokelumne. Sampled since 1979.	38-13-28	121-29-27
33.	Berkeley Beach Frontage Road 1 mile S of Berkeley Marina. Sampled since 1980.	37-52-27	122-18-27
34.	San Francisco Bay at Point Molate Beach 1000 yds N of the Richmond-San Rafael Bridge. Sampled since 1980.	37-55-00	122-25-10
35.	San Pablo Bay at China Camp State Park Beach near the fishing pier. Sampled since 1980.	38-00-03	122-27-40
36.	San Francisco Bay at Paradise Beach County Park. Site sometimes called Tiburon Beach. Sampled since 1980.	37-53-45	122-27-30
37.	San Pablo Bay - Point Pinole, upstream, west of fishing pier. Sampled since 1980.	38-00-33	122-22-00

38.	San Pablo Bay - Point Pinole, downstream, east of fishing pier. Sampled since 1980.	38-00-42	122-21-37
39.	Crockett Beach W of Marina on the beach on the S bank of the Carquinez Strait. Sampled since 1980.	38-03-25	122-13-33
40.	Georgiana Slough 1 mile S of junction with the Sacramento R. Sampled since 1976.	38-13-30	121-31-32
41.	Little Potato Slough, 400 yards S of Hwy 12 in Terminous. Sampled since 1979.	38-06-48	121-29-47
42.	Montezuma Slough, 1400 yards N of Roaring River Slough intake. Sampled 1980 and 1981.	38-06-17	121-53-18
43.	Montezuma Slough at mouth of Roaring River Slough intake. Sampled 1980 and 1981.	38-05-17	121-53-00
44.	Roaring River Slough intake pond at the junction with Montezuma Slough. Sampled in 1980 and 1981.	38-05-27	121-53-13
45.	Steamboat Slough just W of the Steamboat Resort on Island Rd. Sampled 1976-1984.	38-17-56	121-34-45
46.	Three-mile Slough - Brannan Island State Park, at the end of Seven-mile Slough. Sampled since 1976.		

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Research Triangle Park, North Carolina

Hardware: IBM mainframe

Software: STORET, SAS

Volume of Data: 97,000 records are in STORET

Quality Assurance: Computer records are checked against the raw data sheets.

Contact for Data Retrieval

Name: Patricia Brandes
U.S. Fish and Wildlife Service
4001 Wilson Way
Stockton CA 95205

Phone: (209) 466-4421

Data Availability Date: Data from 1976-1985 will be ready to access in January, 1991. The 1986-1988 data will be available in June 1991.

REFERENCES

CDFG. 1987. "The needs of Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin estuary." Exhibit #31 submitted in the State Hearings by the U.S. Fish and Wildlife Service. For copies contact Rick Morat, (916) 978-4613. 179 pages.

Kjelson, M.A. and P.L. Brandes. 1988. Survival of Chinook Salmon Smolts in the Sacramento River Delta During 1988. Annual Progress Report, FY 88 Work Guidance, Fisheries Assistance Office, US Fish and Wildlife Svc., Stockton, CA.

Kjelson, M.A., D. Hood and P.L. Brandes. 1989. Survival and Productivity of Juvenile Chinook Salmon in the Sacramento-San Joaquin Estuary. 1989 Annual Progress Report, FY 89 Work Guidance, Fisheries Assistance Office, US Fish and Wildlife Svc., Stockton, CA.

Kjelson, M.A., B. Loudermilk, D. Hood and P.L. Brandes. 1990. The influence of San Joaquin river inflow, Central Valley and State water project exports and migration route on fall-run chinook smolt survival in the Southern Delta during the spring of 1989. Fisheries Assistance Office, US Fish and Wildlife Svc. and Cal. Dept. of Fish and Game, Stockton, CA.

~Descriptors: bay-delta; biological resources; fisheries; central bay; delta; abundance; water diversion; hydrology and flow; north delta; central delta; south delta; reproduction; cdfg; usfws;

GENERAL INFORMATION AND ABSTRACT

Program: National Marine Recreational Fishery Statistics Survey

Funding Agency: National Oceanic and Atmospheric Administration/National Marine Fisheries Service

Principal Investigator: Dr. Mark Holliday
National Marine Fisheries Service
(301) 427-2328

California contact: Marty Golden
National Marine Fisheries Service
300 S. Ferry St.
Terminal Island, CA 90731
(213) 514-6637

Conducting Agency: National Marine Fisheries Service

Period of Record, Earliest Date: July, 1979

Period of Record, Latest Date: December, 1989

Geographic Boundaries Description:

The Marine Recreational Fisheries Statistics Survey (MRFSS) on the west coast is divided into three subregions: Pacific Northwest (Washington and Oregon), northern California (Monterey county through Del Norte county) and southern California (San Diego county through San Luis Obispo county).

ABSTRACT

The MRFSS was initiated by NOAA/National Marine Fisheries Service (NOAA Fisheries) for West Coast in July 1979. The survey collects statistics on marine recreational fisheries as authorized by the Fish and Wildlife Act of 1956 (Section 5[a][4]), the Migratory Game Fish Study Act of 1959 (Title 16, Chapter 9A, U. S. Code) and the Magnuson Fishery Conservation and Management Act of 1976 (Sections 303 and 304[e]; P.L. 94-265).

The MRFSS consists of two independent but complementary surveys: a telephone survey of households and an intercept survey of saltwater anglers. The telephone

survey collects data on the marine recreational fishing effort in coastal counties. The intercept survey collects data on the catch of marine recreational anglers. Data from the two surveys are combined to provide an estimate of the total fishing effort and catch by marine recreational fishermen. Total effort is estimated as the number of fishing trips and total catch is reported for each species both by quantity and weight. The MRFSS also provides an annual estimate of the number of marine recreational fishermen.

The estimated total catch for northern California was 10.1 to 12.4 million fish in 1986 at the 95 percent confidence level (analyses of 1987 and 1988 data are in progress). The 1986 estimate is not significantly different from the 1985 estimate of 10.5 million fish. During 1986 surf smelt was the leading species in number of fish caught in northern California, accounting for 14 percent of the total catch. Rockfish collectively comprised 30 percent of the total number of fish caught with black, blue, chilipepper, yellowtail and canary rockfish most commonly caught. Sixty percent of the total catch was caught from commercial passenger fishing vessel/charter boats. These boats had the highest catch rate per trip with an average of 8.6 fish. July and August accounted for approximately 32 percent of the total catch for the year.

During 1986 an estimated 632,000 northern California residents went saltwater fishing in this region compared to 725,000 in 1985. Approximately 90 percent of the total number of anglers were northern California residents. Four percent of all households contacted in the telephone portion of the survey indicated some saltwater fishing activity during the year. Approximately 2.8 million fishing trips were taken in northern California in 1986, a slight increase from the 2.5 million trips taken in 1985.

PARAMETERS

MEDIA ANALYZED: Biota

BIOLOGICAL PARAMETERS MEASURED

fish species identification
number by fish species
fish lengths

TAXA

All marine and anadromous finfish except striped_bass caught on vessels for hire and_salmon.

MISCELLANEOUS PARAMETERS MEASURED

Data obtained from the telephone survey includes number of fishermen per household, number of finfishing trips in the last 2-month period, the location of each trip, the mode of each trip and the location of the household. The intercept survey

gathers information on the fishing mode, the state and county of residence, the avidity level and the area of fishing.

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METHODS

SAMPLING METHODS

Telephone Survey

The survey is designed as a stratified random sample with the primary sampling unit being a coastal county household. A strata corresponds to a state/subregion during a 2 month sampling period (wave). A proportional sample allocation based on the historical fishing effort is used to determine the telephone interview quota for each wave. Telephone sampling effort is directed only at households located in coastal counties (see listing below). Households within defined dialing areas are contacted at random at the end of each wave. Telephone interviews are conducted with marine anglers and cover only fishing activity in the previous 2 months.

Intercept Survey

This portion of the MRFSS consists of on-site interviews of marine recreational anglers. Catch and demographic data are gathered. The intercept survey is designed as a stratified random sample with the primary sampling unit being a fishing trip. A strata corresponds to a fishing mode during a 2 month sampling period. Three modes of fishing activity are sampled: shore, commercial passenger fishing vessel (CPFV)/charter boat, and private or rental boat. The shore mode includes fishing from beach/bank sites and from all man-made structures (piers, jetties, bridges etc.). Data collected includes information only regarding the fishing trip just completed (e.g., how long the person had fished, what gear was used), selected demographic information (state and county of residence) followed by an examination of the respondents's catch. Length data are recorded for a sample of each species in the respondent's catch. Weights are calculated from length-weight formulas. State sampling programs specifically target salmon_anglers, therefore, anglers directing their effort at_salmon are not interviewed.

The allocation of interviews by mode and wave is based on empirical data and estimates from previous MRFSS results. Complete subregion-wide site lists are created and site assignments are selected based on historical information on site-specific fishing activity. Sampling is scheduled to cover all weekdays, weekends and holidays.

Telephone Survey

During 1987 and 1988, approximately 11,000 households in northern California were contacted in the telephone survey. Prior to 1987 approximately 18,000 households were contacted.

Intercept Survey

The total number of anglers intercepted was 7,000 for both 1987 and 1988. Prior to 1987 approximately 10,000 anglers were interviewed annually.

SAMPLING FREQUENCY AND LOCATION

Telephone Survey

This portion of the MRFSS is carried out in six 2-week periods of interviewing conducted near the end of each 2-month period of fishing activity. Anglers in fishing households in Del Norte, Humboldt, Mendocino, Sonoma, Marin, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Francisco, San Mateo, Santa Cruz, and Monterey Counties are interviewed.

Intercept Survey

Sampling is conducted continuously in six 2- month sampling periods (waves) from January through December at fishing sites where fishermen are interviewed at the completion of their fishing trip. Selection of specific interview sites is based on historical information on the fishing activity at all sites within the subregion.

ANALYSIS

The raw intercept and telephone survey data are used in a variety of analyses including: year class analyses; length-to-age frequency conversions for estimation of total mortality; distribution of individual species; changes in fishing activity patterns; and socioeconomic analyses. Estimates of total catch and effort can be used in stock assessments and trend analyses.

QUALITY TESTING ASSURANCE AND REPORTING

The estimates derived from the telephone and intercept surveys fall into three categories: estimates of the number of trips taken, the number of finfish caught and/or landed (number and weight), and the number of participants in fishing activities. For the number of trips taken, the estimate of coastal county resident trips is derived from the telephone survey and projections of the number of full-time occupied housing units in the coastal dialing areas. The mean number of fishing trips reported in the telephone survey is multiplied by the estimated number of full-time occupied housing units in the survey dialing area to estimate the total number of marine recreational fishing trips taken by residents of coastal counties in northern California. Ratio estimators are used to account for the proportion of households without telephones and non-coastal county resident and out-of-state resident fishing trips.

Estimates of total number of fish caught are calculated from the estimated total number of fishing trips by mode and the average number of fish caught per trip obtained from the intercept survey. All catch estimates are for individual species.

Estimating the number of participants in fishing activity is complicated by the fact that anglers exhibit varying levels of fishing avidity. Estimates of total participation are made for each subregion on an annual basis. The data for trips and catch are calculated for each sampling strata (i.e. subregion/mode/wave). Estimates of catch and effort by area fished (ocean areas <= 3 miles from shore, ocean areas > 3 miles from shore, etc.) are calculated from the ratio of anglers intercepted reporting fishing in each area to the total number of anglers intercepted in each mode and wave. Annual estimates are calculated by summing the estimates for the six waves from January through December. All data are maintained in their unaggregated form in the MRFSS data base.

DATA STORAGE INFORMATION AND REFERENCES

Location: Silver Spring, MD

Hardware: Data are accessible on a variety of mainframe,mini, and micro computers including IBM-3033's, VAX750's, Burroughs 7800 and various IBM-PC clones.

Storage: NOAA Fisheries data are stored on magnetic tape for mainframe and mini- computer usage and on high density floppy diskettes and removable hard diskette cartridges for use on micro-computers. Data are stored in ASCII, EBCDIC and SAS data library formats.

Volume of Data: Data from the west coast intercept survey (mid-1979 through 1988) require approximately 170 megabytes of storage; data from the telephone survey require approximately 18 megabytes of storage and the expanded trip and catch estimates require approximately 18 megabytes.

Quality Assurance: Data entries are reviewed thoroughly by the telephone and intercept survey contractors, by NOAA Fisheries once it has been keypunched and finally verified by a MRFSS Coordinating Committee comprised of federal and state resource managers.

Contact for Data Retrieval: Mr. Marty Golden
National Marine Fisheries Service
Southwest Regional Office
300 South Ferry Street
Terminal Island, CA 90731

Who Can Access This Information: Requests for MRFSS data should be made to Mr. Marty Golden.

Data Availability: 1979-1986 is available now.

Report Cost: Reports from previous years' surveys are available at no cost as long as supplies last.

Due Date For Manuscript: Reports summarizing the 1987-1990 survey results are anticipated in late 1990.

Location of hard copies: NOAA, National Marine Fisheries Service
Southwest Region
300 S. Ferry Street
Terminal Island, CA 90731

REFERENCES

NOAA Fisheries. 1984. Marine Recreational Fishery Statistic Survey, Pacific coast, 1979-1980. Current Fishery Statistics No. 8321. U.S. Department of Commerce, Washington, D.C. 224pp.

NOAA Fisheries. 1984. Marine Recreational Fishery Statistic Survey, Pacific coast, 1981-1982. Current Fishery Statistics No. 8323. U.S. Department of Commerce, Washington, D.C. 203pp.

NOAA Fisheries. 1985. Marine Recreational Fishery Statistic Survey, Pacific coast, 1983-1984. Current Fishery Statistics No. 8325. U.S. Department of Commerce, Washington, D.C. 189pp.

NOAA Fisheries. 1986. Marine Recreational Fishery Statistic Survey, Pacific coast, 1985. Current Fishery Statistics No. 8328. U.S. Department of Commerce, Washington, D.C. 109pp.

NOAA Fisheries. 1987. Marine Recreational Fishery Statistic Survey, Pacific coast, 1986. Current Fishery Statistics No. 8393. U.S. Department of Commerce, Washington, D.C. 114pp.

~**Descriptors:** bay-delta; fishing gear; biological resources; sport fishing; commercial fishing; recreation; resource management; sampling methods; abundance; fisheries; community structure; species distribution; population dynamics;

GENERAL INFORMATION AND ABSTRACT

Program:	Neomysis-Zooplankton Study
Funding Agency:	California Department of Fish and Game
Principal Investigator:	Jim Orsi California Department of Fish and Game (209) 466-4421
Conducting Agency:	California Department of Fish and Game
Study Cost:	$182,000 per year
Period of Record, Earliest Date:	June, 1968 for the *Neomysis* collection; January, 1971 for the zooplankton collection
Period of Record, Latest Date:	Present
Geographic Boundaries Description:	Samples are collected from San Pablo Bay, Carquinez Strait, Suisun Marsh, and throughout the Delta from Hood on the Sacramento River, to Stockton and to Clifton Court.

ABSTRACT

Zooplankton constitute an essential food source for fish, especially young fish and all stages of many forage fishes. In the San Francisco Bay-Delta, young striped bass and other species prey upon zooplankton. One aspect of a broad program investigating trends in striped bass abundance (the striped bass element of the Interagency Ecological Studies Program) is long- term research (beginning in 1968) conducted by the California Department of Fish and Game on the population dynamics of *Neomysis* and other zooplankton in the northern reach of the Bay and in the Delta. This research allows assessment of trends in abundance of zooplankton species in relation to environmental conditions, such as phytoplankton abundance and Delta hydrologic variation.

DFG presented an analysis of these data in an exhibit submitted to the State Water Resources Control Board for the Bay- Delta Water Rights Hearings (DFG 1987). Four groups of zooplankton have been the subject of this study: 1) *Neomysis mercedis*; 2) copepods; 3) cladocerans; and 4) rotifers. Members of each of these groups are eaten by young-of-the-year striped bass. Adult copepods and cladocerans are the first food items taken by young striped bass, and *Neomysis* dominates their diet at a later stage.

There has been a long-term decline in abundance of all native zooplankton taxa with the exceptions of *Acartia* (a copepod) and *Neomysis*. However, three accidentally introduced Asian copepods became abundant in 1979 and 1980 and have helped maintain the abundance of the copepod population as a whole. One of these introduced species, *Sinocalanus*, is suspected of virtually eliminating a native but relatively scarce *Diaptomus* species in much of the Delta, and may have affected the distribution and abundance of the important native *Eurytemora*. *Neomysis* was abundant only in two years (1980 and 1982) after the 1976-1977 drought. High flows occurred in the spring of both those years.

Multiple regression analyses of the influence of several independent environmental variables (including chlorophyll *a*, temperature, salinity, and water project export pumping rates) on annual average zooplankton abundance were conducted. Chlorophyll *a* was found to be significantly correlated to abundance of nearly all taxa ($p < .05$). The effects of export pumping on zooplankton abundance in Old River and the San Joaquin River were assessed. Abundance in Old River appears to be unrelated to pumping volumes, but sharply affected by large cross-Delta flows to the pumps.

PARAMETERS

PHYSICAL PARAMETERS MEASURED

secchi disc depth
electrical conductivity, surface and bottom
water temperature, surface

BIOLOGICAL PARAMETERS MEASURED

chlorophyll *a*

Neomysis	egg and embryo counts
Neomysis	egg stage
Neomysis	juvenile, gravid or non-gravid female, or male
Neomysis	length
Neomysis	density
Zooplankton	density by taxon

TAXA

Acartia	copepod
Asplanchna	rotifer
Barnacle nauplii	*barnacle young*
Bosmina longirostris	cladoceran
Crab zoea	*crab young*
Cyclops	copepod
Daphnia	cladoceran
Diaphanosoma	cladoceran
Diaptomus	freshwater copepod
Eurytemora affinis, all life stages	calanoid copepod
Harpacticoid	*copepod*

Keratella	*rotifer*
Limnoithona sinensis	Chinese cyclopoid copepod
Neomysis mercedis	opossum shrimp
Oithona davisae	Asian copepod
Oithona similis	copepod
Pseudodiaptomus forbesi	Chinese copepod
Pseudodiaptomus marinus	Chinese copepod
Polyarthra	rotifer
Sinocalanus doerrii, all life stages	Chinese copepod
Synchaeta	rotifer
Synchaeta bicornis	rotifer
Trichocerca	rotifer

METHODS

SAMPLING METHODS

Collection of *Neomysis* in the upper estuary began in June 1968; zooplankton collection began in January 1971. The *Neomysis* net was initially made of 1 mm silk bolting cloth. From 1971 through 1973 it was made of 0.93 mm mesh nylon cloth. In 1974 mesh size was again altered to 0.505 mm, in an effort to sample 2-3 mm mysids more effectively. The length and mouth area after 1974 were 1.48 m and 0.064 square meters, respectively. In all years the net tapered to 7.6 cm at the cod end where a jar screened with 0.505 mm mesh wire cloth captured the mysids. Water volumes filtered by the Neomysis net were measured by flow meters.

A Clarke-Bumpus net was used to sample other zooplankton. This net was made of 154 um nylon mesh, had a mouth area of 0.013 square meters, and was 73 cm long tapering to a 4.5 cm diameter at the cod end. A screened bottle at the end of the net collected the organisms. Stepwise bottom to surface oblique tows lasting 10 minutes were made, using both nets simultaneously.

Microzooplankton were collected using a pump. Vertical samples were obtained by raising the hose from the bottom to the surface. All Neomysis and zooplankton samples were preserved and dyed.

Surface temperature, surface and bottom specific conductance, and the algal pigment chlorophyll *a* are measured at each sampling site.

SAMPLING FREQUENCY AND LOCATION

Number of Stations: A total of 88 stations have been sampled throughout the study.

Surveys began in 1968 and were initially conducted once a month throughout the year. In 1972, two surveys were conducted each month from April through October;, since 1976, two surveys have been conducted each month from March

through October. From December through February in 1968-1972 and 1977-1982 surveys were conducted once a month. Not all of the stations were sampled every year; stations in San Pablo Bay and the Carquinez Strait were usually not sampled when the pre-tow surface electrical conductivity reading was above 20,000 umhos. Stations located in the Delta were frequently not sampled until March. A number of stations in the northern Delta were sampled only during the drought year of 1977.

		Latitude	Longitude
1.	Turner Cut at McDonald Ferry	37-58-47	121-28-27
2.	Sacramento Ship Channel bet lights 51/52	38-14-16	121-40-17
3.	Sacramento Ship Channel bet lights 55/56	38-16-18	121-39-38
4.	Sacramento Ship Channel bet lights 61/62	38-20-31	121-38-37
5.	Sacramento Ship Channel bet lights 65/66	38-24-18	121-36-41
6.	Sacramento Ship Channel bet lights 69/70	38-28-12	121-35-02
7.	West Canal 230M downstr of Clifton Ct Gate	37-50-04	121-33-14
8.	Big Break	38-01-05	121-42-38
9.	Franks Tract	38-02-38	121-36-49
10.	Suisun Bay at smoke stacks on west shore	38-03-35	122-06-35
11.	Suisun Bay upstream of light 4	38-04-19	122-05-46
12.	Suisun Bay bet last row of ships at lt 4	38-05-35	122-04-09
13.	Grizzly Bay between lights 9 and 10	38-06-55	122-03-07
14.	Grizzly Bay 91M southeast of Dolphin	38-07-02	122-02-50
15.	Suisun cutoff at Anamesa Slough	38-05-30	122-00-51
16.	Sacramento River Ch 500m off Freeman Isl	38-04-28	121-59-20
17.	Honker Bay 366M off N. shore nr Wheeler Islbs	38-04-26	121-56-12
18.	Sherman Lake	38-02-34	121-47-34
19.	San Pablo Bay at lights 11 and 12	38-01-36	122-19-25
20.	False River 640M west of Piper Slough	38-03-23	121-39-48
21.	Middle River 914M S of Bacon Isl. Bridge	37-58-15	121-32-04
22.	Middle River at Victoria Canal	37-53-30	121-20-20
23.	North Fork Mokelumne River	38-08-44	121-33-24
24.	Mokelumne River 1.6 km above river fork	38-14-00	121-29-20
25.	Napa River	38-11-15	122-10-40
26.	Old River at south end of Holland Tract	37-58-58	121-34-48
27.	San Pablo Bay at light 2	37-58-16	122-25-57
28.	San Pablo Bay at light BW E	38-00-40	122-24-00
29.	San Pablo Bay at lights 9 and 10	38-02-25	122-21-00
30.	San Pablo bay at light 15	38-03-28	122-17-20
31.	Carquinez Strait at light 2	38-03-58	122-14-35
32.	Carquinez Strait at Glencove Harbor	38-03-37	122-12-25
33.	Carquinez Strait at light 22	38-03-09	122-10-42
34.	Carquinez Strait 46M - 91m off Ozol Pier	38-01-45	122-09-30
35.	Carquinez Strait at Pier E. of Marina	38-01-54	122-08-07
36.	Sacramento River at Avon Pier	38-02-57	122-05-32
37.	Sacramento River at lights 11 and 12	38-03-54	122-03-40

38.	Sacramento River 457 M upstr of light 16	38-03-54	122-02-03
39.	Sacramento River 183 M upstr of light 19	38-03-36	121-59-45
40.	Sacramento River at lights 24 & 25	38-03-29	121-57-55
41.	Sacramento River at Simmons Point	38-02-47	121-55-02
42.	Sacramento R at mouth of Mallard_Slough	38-02-45	121-54-23
43.	Sacramento River at light 31	38-02-56	121-53-05
44.	Sacramento River bet. lights 33 and 34	38-03-35	121-52-06
45.	Sacramento River bet. lights 5 and 6	38-03-45	121-49-44
46.	Sacramento R 183 M upstr of lights 9 & 10	38-03-42	121-47-46
47.	Sacramento R 457 M upstr of lights 13:14	38-05-04	121-44-17
48.	Sac R at NE end of Decker Isl mid-channel	38-06-31	121-42-52
49.	Sacramento R at Rio Vista Coast_Guard St.	38-05-52	121-41-01
50.	San Pablo Bay near Pinole Point	38-01-50	122-22-15
51.	Suisun Bay off Bulls Head near Martinez	38-02-40	122-07-00
52.	Sacramento R 150 yds s of Rio Vista Bridge	38-09-27	121-41-01
53.	Sacramento River at light 37	38-10-39	121-40-00
54.	Sacramento River at NW end of Ida Island	38-10-20	121-38-38
55.	Sacramento River at Isleton Bridge	38-10-20	121-35-33
56.	Sacramento River near Ryde	38-14-29	121-33-29
57.	Sacramento River at Greens Landing	38-20-52	121-32-25
58.	San Joaquin River at Light 2	38-01-54	121-50-07
59.	San Joaquin River between lights 7 and 8	38-01-20	121-48-13
60.	San Joaquin River between lights 10 and 11	38-01-07	121-45-49
61.	San Joaquin R bet light 19 & south shore	38-02-07	121-42-24
62.	San Joaquin River at light 24	38-03-09	121-41-17
63.	San Joaquin River 549 M upstr of light 26	38-04-24	121-40-36
64.	San Joaquin R 183 M downstr of light 34	38-05-22	121-39-03
65.	San Joaquin R 183 M downstr of light 42	38-06-13	121-36-20
66.	San Joaquin River at light 53	38-04-40	121-34-13
67.	San Joaquin R at mouth of Middle River	38-02-39	121-31-45
68.	San Joaquin River between lights 5 and 6	38-00-07	121-26-57
69.	San Joaquin R 183M downstr of lights 39:40	37-58-42	121-22-55
70.	South fork Mokelumne River at Staten Isl	38-07-34	121-29-43
71.	South fork Mokelumne R. 1.6 km above Terminous	38-07-34	121-29-43
72.	Cache Slough at light 44	38-12-41	121-41-30
73.	Disappointment Slough 366 M down from Rindge Tract Bridge	38-02-38	121-25-35
74.	Georgiana Slough near Isleton	38-09-03	121-35-47
75.	Hog Slough near Thornton	38-10-10	121-26-50
76.	Montezuma Slough second bend from mouth	38-08-07	121-54-43
77.	Montezuma Slough past abandoned railroad	38-04-40	121-53-00
78.	Steamboat Slough	38-11-50	121-36-57
79.	Suisun Slough at mouth of Volanti Slough	38-10-50	122-02-50
80.	Sycamore Slough at mouth	38-08-28	121-30-00
81.	White Slough at Correa ferry	38-05-01	121-28-12

ANALYTICAL METHODS

Neomysis samples were subsampled before counting. All mysids in a selected subsample were counted. Initially, a minimum count of 200 was required; this was increased to 400 in 1984. Lengths of the first 100 mysids counted were recorded. Beginning in 1976 they were identified as being juvenile, gravid female, non-gravid female, or male. Offspring from the brood pouches of twenty females from each sample, when available, were counted and assigned to three developmental stages: eggs, comma-shaped embryos, and eyed embryos. Estimates of the volume of water originally filtered are used to convert the counts into densities in the water column of the sampling site.

Clarke-Bumpus samples were divided into 1 ml sub-samples and placed in Sedgewick-Rafter cells. All animals were identified and counted under a compound microscope. Additional 1 ml sub-samples were examined until at least 200 animals had been counted. Organisms present in the pump samples were collected on a 43 um mesh screen, then identified and counted in a Sedgewick-Rafter cell. The counts and measures of the amount of water filtered per sample are used to determine the approximate density of organisms in the water column at each sampling site.

Zooplankton taxa identified varied over the years. From 1972 to 1975 an effort was made to identify organisms to species. Thereafter, identifications were to genus level, except for important species or when only one species was present in a genus.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: DFG Rancho Cordova

Hardware: VAX

Software: SAS

Volume of Data: Approximately 14,000 records

Quality Assurance: 3,000 random digit checks

Contact for Data Retrieval

Name: Anne Baker

Address: Biometrics - CA Department of Fish and Game
1701 Nimbus Road Suite E
Rancho Cordova CA 95670

Phone: (916) 355-7008
Location: Research Triangle Park, North Carolina
Hardware: IBM mainframe

Software: STORET

Volume of Data: Approximately 790,000 records

Storet Agency Code: 21CAL-85

Quality Assurance: 3,000 random digit checks

Contact for Data Retrieval

Name: Phil Daniels
State Water Resources Control Board

Phone: (916) 322-4514

Data Availability Date: Immediately

Map Information

Availability: On request

Subject Description: Sampling locations

Cost: no charge

Contact: Jim Orsi
California Department of Fish and Game
4001 Wilson Way
Stockton CA 95205

REFERENCES

DFG. 1987. "Zooplankton population trends and environmental relationships." DFG Exhibit #28 submitted in the State Hearings, available from the Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA, 95205. 88 pages.

Ferrari, F.D. and James Orsi. *Oithona Davisae*, new species, and *Limnoithona sinensis* (Burkhardt, 1912) (Copepoda: oithonidae) from the Sacramento-San Joaquin Estuary, California. Journal of Crustacean Biology, 4(1): 106-126.

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Orsi, J.J. and T.E. Bowman, D.C. Marelli, and A. Hutchinson. 1983. Recent introduction of the planktonic calanoid copepod *Sinocalanus doerrii (Centropagidae) from mainland China to the Sacramento-San Joaquin Estuary of California. Journal of Plankton Research 5(3): 357-375.*

Orsi, J.J. and W.L. Mecum. 1986. Zooplankton distribution and abundance in the Sacramento-San Joaquin Delta in relation to certain environmental factors. Estuaries 9: 326-339.

~**Descriptors:** bay-delta; salinity; biological resources; Suisun Bay; abundance; reproduction; species diversity; invertebrates; north delta; south delta; west delta; central delta; east delta; cdfg;

GENERAL INFORMATION AND ABSTRACT

Program:	South Bay Fish Survey
Funding Agency:	NOAA/National Marine Fisheries_Service (NMFS)
Principal Investigator:	Donald Pearson, NMFS (415) 435-3149
Conducting Agency:	Marine Ecological Institute (MEI)
Period of Record, Earliest Date:	February 1973
Period of Record, Latest Date:	June 1982
Geographic Boundaries Description:	Five stations were sampled between San Mateo and Dumbarton Bridges. Each station was bounded on one side by the deepwater channel and on the opposite side by shallows.

ABSTRACT

The objective of this study was to describe the physical and ichthyological changes occurring seasonally and annually in the South San Francisco Bay, based on the results of 2,561 otter trawl and water samples obtained between February 1973 and June 1982.

Temperature varied predictably among seasons in a pattern that varied little between years. Salinity also underwent predictable seasonal changes but the pattern varied substantially between years. The most abundant species of fish were northern anchovy (*Engraulis mordax*), English sole (*Parophrys vetulus*), and shiner surfperch (*Cymatogaster aggregata*). A total of 59 species were collected during the study. The majority of fish species were most abundant during wet years and least abundant during dry years. Species diversity was highest during the spring and early summer, with no detectable annual trends.

Species composition changed extensively between seasons and between years, particularly years with extremely high or extremely low freshwater inflows. All the common species exhibited clustered spatial distributions. Such spatial clustering could affect the interpretation of data from estuarine sampling programs. Gobies (Family Gobiidae) were more abundant during flood tides than ebb tides. English sole were significantly more abundant in shallower areas. Shiner surfperch showed significant differences in abundance between sample areas.

PARAMETERS

Media Analyzed: Biota. Water.

BIOLOGICAL PARAMETERS MEASURED
species abundance

PHYSICAL PARAMETERS MEASURED
water temperature

CHEMICAL PARAMETERS MEASURED
salinity

TAXA

Acanthogobius flavimanus	yellowfin goby
Acipenser medirostris	green sturgeon
Acipenser transmontanus	white sturgeon
Alosa sapidissima	American shad
Amphistichus argenteus	barred surfperch
Artedius notospilotus	bonyhead sculpin
Atherinops affinis	topsmelt
Atherinopsis californiensis	jacksmelt
Citharichthys sordidus	pacific sanddab
Citharichthys stigmaeus	speckeled sanddab
Clupea harengus	pacific herring
Cymatogaster aggregata	shiner surfperch
Damalichthys vacca	pile surfperch
Dorosoma petenense	threadfin shad
Embiotoca jacksoni	black surfperch
Engraulis mordax	northern anchovy
Genyonemus lineatus	white croaker
Gillichthys mirabilis	longjaw mudsucker
Girella nigricans	opaleye
Glyptocephalus zachirus	rex sole
Hyperprosopon argenteum	walleye surfperch
Hypomesus pretiosus	surf smelt
Hypsopsetta guttulata	diamond turbot
Hypsurus caryi	rainbow surfperch
Ilypnus gilberti	cheekspot goby
Lepidogobius lepidus	bay goby
Leptocottus armatus	staghorn sculpin
Microgadus proximus	pacific tomcod
Micrometrus minimus	dwarf surfperch
Morone saxatilis	striped bass
Mustelus henlei	brown smoothhound
Myliobatus californica	bat ray
Notorynchus maculatus	sevengill shark

Ophiodon elongatus	lingcod
Parophrys vetulus	English sole
Paralichthys californicus	California halibut
Pholis ornata	saddleback gunnel
Platichthys stellata	starry flounder
Pleuronichthys coenosus	C-O sole
Porichthys notatus	plainfin midshipman
Psettichthys melanostictus	sand sole
Raja binoculata	Big skate
Raja inornata	California skate
Racochilus toxotes	rubberlip surfperch
Roncador stearnsii	spotfin croaker
Sardinops sagax caeruleus	Pacific sardine
Scorpaenichthys marmoratus	cabezon
Sebastes auriculatus	brown rockfish
Sebastes dallii	calico rockfish
Spirinchus starksi	night smelt
Spirinchus thaleichthys	longfin smelt
Squalus acanthias	spiny dogfish
Symphurus atricauda	California tonguefish
Syngnathus leptorhynchus	Bay pipefish
Triakis semifasciata	leopard shark
Tridentiger trigonocephalus	chameleon goby

METHODS

SAMPLING METHODS

Water samples were taken with a Kemmerer bottle from 1m below the surface. Temperature was measured by either electronic meter or thermometer, both with an accuracy of 0.5 deg C. Salinity was determined by hydrometer with accuracy of 0.5ppt.

For the trawl samples, an otter trawl with 4.9 m headline, 3.8 cm mesh and 0.64 cm mesh in the codend, secured to the ship with 23 meter warps, was used. After the net was fully deployed, a timer was set for 10 minutes after which the net was recovered manually. The catch was placed in holding tanks on deck where the fish were counted and identified.

SAMPLING FREQUENCY AND LOCATION

Number of Sampling Sites: 5

Locations

The five loosely defined sampling stations were located between the San Mateo and Dumbarton Bridges. Each station was bounded on one side by the

deepwater channel and on the opposite side by shallows, with roughly defined endpoints. The stations were in depths of 1.5 to 14 m. Stations 1, 3 and 5 were on the southwest side of the deepwater channel and stations 2 and 4 were on the northeast side. Frequency of trawls used in the study varied between 5 and 50 times per month.

ANALYTICAL METHODS

Data were collected during cruises conducted as part of an MEI educational program. Captured taxa were organized into the following classification: Primary species - readily identifiable to species and common; Primary family - readily identifiable to family and common; Secondary species - readily identifiable to species and uncommon (less than one per cent of catch); Secondary family - readily identifiable to family and uncommon (less than one per cent of catch); Tertiary species - identification questionable and/or uncommon or rare in the catch; Tertiary family - identification questionable and/or uncommon or rare in the catch. Data on the primary species/families were used to calculate seasonal and yearly trends and to statistically test the effects of trawl variables. The secondary species/family data were deemed inadequate for statistical analysis and only yearly and seasonal trends were used. Data on the tertiary species/families were considered unreliable and no analyses were performed. The results were reported as mean catch-per-trawl per month. Data from months with less than 5 trawls were not used due to the possibility of clustered distributions which might reduce the reliability of abundance estimates. Seasonal trends were determined from the unweighted mean monthly catch-per-trawl. To determine yearly trends, relative values for the month of peak abundance were compared for each of the primary species/families showing pronounced seasonal trends. Otherwise, the mean monthly catch values were compared over the entire year.

Since no attempt was made to sample equally at all depths, tide states, times, or sampling stations, the effects of these variables on catches were tested prior to examining temporal and spatial distribution patterns of the primary species/families. The 15 months showing highest abundances of the primary species were selected from the data set. A Friedman's test (non-parametric, randomized block design) was employed, with each month used as a block. To test location effects, samples were sorted by station and mean catch-per-trawl was calculated and stations ranked within the block. To test for tidal effects, trawls from each month were divided into flood and ebb tide groups for mean catch-per-trawl calculations. To test for time of day effect, samples were sorted into trawls made before 10:00 a.m. and trawls made after 12:00 p.m. To test for the effect of depth on catch, samples were divided into those taken from less than 3 meter depths and those taken in depths greater than 4 meters. To examine distribution patterns, the variance-to-mean ratios for each month were plotted on histograms for each species, and then analyzed for evidence of clustering. All histograms of the primary species/families showed a variance-to-mean ratio much greater than 1.0, which is clear evidence of clustering. There was no difference in catch based on time or tide, which is probable indication of the spatial nature of the clustering.

QUALITY ASSURANCE TESTING AND REPORTING

none detailed in the report

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DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: National Marine Fisheries Service
3150 Paradise Dr.
Tiburon CA

hardcopy only

Contact for Data Retrieval

Name: Donald Pearson
National Marine Fisheries Service
3150 Paradise Dr.
Tiburon CA 94920

Phone: (415) 435-3149

REFERENCES

NOAA. 1989. Survey of fishes and water properties of South San Francisco Bay, California, 1973-82. NOAA Technical Report NMFS 78. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Seattle, WA, 98115.

~**Descriptors**: bay-delta; community structure; diversity; population dynamics; taxonomy; fisheries; biological resources; taxonomic search; other parameters; pollutants and related parameters; delta outflow; freshwater inflow;

GENERAL INFORMATION AND ABSTRACT

Program:	Striped Bass Egg and Larva Survey
Funding Agency:	Department of Fish and Game State Water Resources Control Board Environmental Protection Agency
Principal Investigator:	Lee W. Miller Department of Fish and Game (209) 466-4421
Conducting Agency:	Department of Fish and Game
Period of Record, Earliest Date:	1966-1973, 1975-1977, 1984-1986, 1988, 1989
Period of Record, Latest Date:	Present
Geographic Boundaries Description:	Samples are collected from the area bounded by Suisun Bay, Colusa, and the San Joaquin River at Empire Tract.

ABSTRACT

Monitoring of the striped bass (*Morone saxatilis*) population has been conducted by the California Department of Fish and Game (DFG) since the Central Valley Project began in the mid-1950's, in recognition of the probable adverse effects of water diversion on this valuable fishery. This program was expanded, as part of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, when the State Water Project pumps began operating in the Delta in the late 1960's. The general objective of the program is to determine factors responsible for annual fluctuations in the numbers of juveniles as estimated by an index of their abundance at 38 mm, and how the abundance at that stage affects numbers of fish eventually entering the fishery. Abundance indices of several life stages (eggs and larvae, juvenile, and adult) are computed. Statistical relationships between the abundance indices themselves or between the indices and measured environmental variables are assessed. These statistical relationships indicate factors that may control the distribution and abundance of striped bass and that may deserve additional study.

An immense amount of data has been collected under this program. Different facets of the program have been separated in this index, as even the individual facets comprise large datasets in their own right. For more information on monitoring of the striped bass fishery please refer to other DFG studies entitled "Striped Bass Summer Tow Net Study" and "Midwater Trawl Study".

The distribution and abundance of striped bass eggs and larvae are examined to estimate survival during this critical life stage (DFG 1988). Sampling occurs during and after the annual spring spawning migration in the Sacramento and San Joaquin Rivers, the Delta, and Suisun Bay and San Pablo Bay. In wet years sampling has been extended into Carquinez Straights. Annual larvae indices for the estuary demonstrate a wide range of abundance over the years studied (1968, 1970-1973, 1975, 1977, 1984-1986, 1988, 1989) Data collected in some years are not included because different gear were used [1966], high flows flushed larvae out of the sampling area [1967, 1969], or sampling was inadequate [1976]. Highest abundance indices were observed from 1970-1975. The index of 6mm abundance was extremely low in 1977 and 1984. In 1985 and 1986 this index was almost three times higher than in 1984. Different rates of survival of these larvae in 1985 and 1986, however, had pronounced effects on year class abundance. The 1985 year class was the least abundant ever measured, while the 1986 year class was the most abundant since 1975. For almost all sizes of larvae, the 1984-1986 abundance indices were lower than the indices for the pre-decline years (1968-1975) when adult stocks and egg production were still high.

Low 38 mm indices have been preceded by low abundances of larvae 8mm or larger, and higher 38 mm indices have been preceded by higher production of larvae. Environmental factors are also thought to be critical in controlling the survival of larvae to the 38 mm stage. DFG researchers currently have evidence that the striped bass decline since 1977 as measured by the 38 mm abundance index, is due to a reduction in total egg production by the adult stocks. The lower egg production is caused by lower recruitment which is a result of entrainment losses. Although mortality rates of larva vary from year to year in response to food supply and other factors affecting year class strength, the driving mechanism for the decline appears to be reduced egg production due to entrainment losses at the water export pumping facilities in the South Delta.

PARAMETERS

Media Analyzed: Water.

BIOLOGICAL PARAMETERS MEASURED

larval striped bass stomach contents
striped bass larval abundance from 6-14 mm
(other fish larvae are identified, but not measured)
striped bass live egg abundance at 0-8 hours, and 9-36 hours
striped bass dead egg abundance and total egg abundance
zooplankton density (1984-86, 1988, 1989)
otoliths collected for growth rates (1988)

CHEMICAL PARAMETERS MEASURED

chlorophyll *a* (1984-1986, 1988)
pheophytin *a* (1984-1986, 1988)

Other Parameters Measured

electrical conductivity
water temperature
water transparency

TAXA

Acartia	copepod
Alosa sapidissima	*American shad*
Asplanchna	*rotifer*
Bosmina	cladoceran
Calanoid	copepod
Centrarchid	
Corophium	amphipod
Cyclopoid	copepod
Cyc. vernalis	copepod
Cyprinid	
Daphnia	cladoceran
Diaphanosoma	cladoceran
Diaptomus	copepod
Dorsoma petenense	Threadfin shad
Eurytemora affinis	copepod
Harpacticoid	copepod
Keratella	*rotifer*
Misc sp.	
Morone saxatilis	striped bass
Nauplii	copepod
Neomysis	possum shrimp
Oithona davisae	copepod
Oithona similis	copepod
Other cladocerans	
Other copepods	
Other rotifers	
Percina macrolepida	Bigscale logperch
Polyarthra	rotifers
Pseudodiaptomus	copepod
Sculpin	
Sinocalanus	copepod
Synchaeta	rotifer
Synchaeta bicornis	rotifer
Trichocerca	rotifer

METHODS

SAMPLING METHODS

Samples are collected by towing fine-mesh (505 um) nets for standardized time intervals at several locations in and downstream of the major striped bass spawning areas in the Sacramento and San Joaquin Rivers. The survey is

generally timed to measure all significant spawning activity in the two systems. Stations monitored also are adjusted each year, with more downstream sites sampled in high flow years and fewer sampled in low flow years. Samples are preserved and transported to the laboratory. To assess the food supply for larval bass, zooplankton are sampled at each station by two techniques: pumps are used to collect small rotifers and nauplii (<0.5 mm); and Clarke-Bumpus nets (154 um) are used to collect larger zooplankton (copepods and cladocerans). Also, chlorophyll *a* samples are collected from a depth of 1.2 m. Pump sampling and chlorophyll a sampling was discontinued in 1989.

SAMPLING FREQUENCY AND LOCATION

Number of Stations: A total of 81 stations have been sampled; approximately 60 stations are sampled each year.

Surveys are generally conducted from mid-April to mid-July. Prior to 1984, samples were collected every other day. From 1984 to the present samples were collected every fourth day except on the spawning grounds on the San Joaquin and Sacramento Rivers, where sampling is conducted every other day until the cessation of egg occurrence in the sample.

Spawning surveys were conducted in the Sacramento River above Rio Vista every second day during the spawning season in 1972, 1973, 1975, 1977, and 1984-1986. Striped bass egg abundance was measured at 32 to 43 stations, depending on the year. These stations are located at 2 mile intervals from Benicia in Suisun Bay, to Rio Vista on the Sacramento River, and to Medford Island on the San Joaquin River. In some years additional sites were sampled at Carquinez Strait, upper Suisun, Grizzly and Honker bays, and Montezuma Slough.

		Latitude	Longitude
ELS071	Delta Cross Chanl 600 yds from Sacto River Intersection Sampled in 1972, 1973, 1975, and 1977.	38-14-45	121-30-25
ELS414	Suisun Bay NW of light 2, NE of Boom Station added in 1984.	38-03-13	122-06-45
ELS416	Suisun Bay 550 yards north of light 4 near reserve fleet Station added in 1984.	38-04-06	122-05-34
ELS063	Suisun Bay 250 yds SW at 220 of light 8 Sampled only in 1970. Data estimated for this station in all other years.	38-05-35	122-04-15
ELS064	Grizzly Bay 1000 yards East of Dolphin Sampled only in 1970. Data for this	38-06-56	122-01-45

station was estimated in all other years.

ELS515	Suisun cutoff 550 yds SE at 150 from Pt. Buckler. Station added in 1984.	38-05-28	122-00-50
ELS065	Suisun Bay 400 yds from W tip of Freeman Island. Station was set up in 1970, but never sampled.	38-04-40	121-59-40
ELS066	Honker Bay 1400 yds SE at 100 from Palo Alto on Snag Island, due South of entrance to Roaring River Slough Sampled only in 1970.	38-04-10	121-57-25
ELS061	False River 1 K upstream from the mouth In False River 1000 yards downstream from the entrance of Taylor Slough. Sampled 1966-1977, except 1974	38-03-25	121-40-07
ELS060	Old River north end of Franks Tract Sampled 1966-1977, except 1974.	38-03-30	121-34-55
ELS401	Carquinez Straits along C&H Sugar plant dock east of bridge Station added in 1984.	38-03-34	122-12-50
ELS403	Carquinez Straits - edge of flats north channel near Benicia W of light 23. Station added in 1984.	38-02-48	122-10-10
ELS407	Carquinez Straits - midchannel 1600 yards east of light 23 Station added in 1984.	38-02-04	122-08-32
ELS001	Suisun Bay 1700 yards upstream from Southern Pacific railroad bridge Sampled 1966-1977, except 1974.	38-02-45	122-06-10
ELS003	Suisun Bay upstream from light 10 Center of Sacramento R. ship channel Sampled 1966-1977, except 1974.	38-03-08	122-04-15
ELS005	Suisun Bay upstream from light 16 in center of Sacramento R. ship channel Sampled 1966-1977, except 1974.	38-03-52	122-02-20
ELS007	Suisun Bay upstream from light 19 in ship channel. Sampled 1966-1977,	38-03-30	121-59-55

	except 1974.		
ELS009	Sacramento R 550 yards upstream from light 24 in center of Sac. R. ship ch Sampled 1966 - 1977, except 1974.	38-03-25	121-57-30
ELS011	Sacramento River at light 27 in ship channel. Sampled 1966-1977, except 1974.	38-03-00	121-56-00
ELS013	Sac River 1500 yards upstream from light 28. Sampled 1966-1977, except 1974.	38-02-45	121-54-00
ELS015	Sac R 2090 yds dwnstr from light 34 Sampled 1966-1977, except 1974.	38-03-25	121-52-15
ELS017	Sac River between lights 11 and 13 Sampled 1966-1977, except 1974.	38-03-47	121-50-40
ELS019	Sac River upstr from lights 7 and 8 in the ship channel Sampled 1966-1977, except 1974.	38-03-37	121-48-15
ELS021	Sacramento River 500 yards downstream from lights 13 and 14 Sampled 1966-1977, except 1974.	38-04-20	121-46-25
ELS023	Sacramento River 330 yds downstream lights 15 and 16 Sampled 1966-1977, except 1974.	38-05-15	121-44-40
ELS025	Sacramento River ship channel opposite end of Decker Island Sampled 1966-1977, except 1974.	38-06-22	121-43-00
ELS027	Sac River 270 yds upstr from light 23 Sampled 1966-1977, except 1974.	38-07-35	121-41-48
ELS029	Sac River at lights 27 and 28 Sampled 1966-1977, except 1974.	38-09-05	121-41-15
ELS0772	Sac River 600 yds S of landing No 40 Sampled 1972, 1973, 1975, and 1977.	38-11-15	121-34-50
ELS073	Sacramento River at Vorden Sampled 1972, 1973, 1975, and 1977.	38-16-35	121-32-30

ELS735	Sacramento River at Courtland about 1000 yards above Sutter Slough Station added in 1977.	38-20-02	121-34-10
ELS074	Sacramento River at Rosebud Landing Sampled in 1972, 1973, 1975, and 1977.	38-23-14	121-30-50
ELS745	Sacramento River above Clarksburg, 400 yds below Eagles Point Landing Station added in 1977.	38-26-09	121-31-35
ELS075	Sac River 500 yards S of light 31 Sampled in 1972, 1973, 1975, and 1977.	38-28-35	121-32-30
ELS755	Sacramento River above Chicory Bend at light 45 Station added in 1977.	38-31-58	121-31-34
ELS076	Sacramento River just south of junction with the American River Sampled in 1972, 1973, 1975, and 1977.	38-35-47	121-30-25
ELS7765	Sacramento River 1350 yards upstr from buoy 16, Wing Dam marker Sampled in 1972, 1973, 1975, and 1977.	38-38-18	121-33-46
ELS077	Sacramento River at buoy 27 at S. end of Elkhorn Ferry shoaling area Sampled in 1972, 1973, 1975, and 1977.	38-39-53	121-36-45
ELS775	Sacramento River at buoy 48 downstr end of Pritchard Lake shoaling area Sampled in 1972, 1973, 1975, and 1977.	38-43-25	121-36-15
ELS078	Sacramento River 800 yards upstr from junction with Sac Slough, 1800 yds upstr from junction with the Feather River Sampled in 1972, 1973, 1975, and 1977.	38-46-37	121-37-45
ELS785	Sacramento River 1.4 miles downstr from Portuguese Bend, near Wild Irishman Bend Sampled in 1972, 1973, 1975, and 1977.	38-46-24	121-41-10
ELS079	Sacramento River 1100 yards upstr from Knights Landing Sampled in 1972, 1973, 1975, and 1977.	38-48-40	121-43-21

ELS795	Sac River 1300 yards N of Railroad Bend Sampled in 1972, 1973, 1975, and 1977.	38-51-36	121-33-53
ELS080	Sacramento River 2200 yards downstream from Tyndall Mound Sampled in 1972, 1973, 1975, and 1977.	38-52-14	121-48-10
ELS805	Sac River 800 yds downstr from Poker Bend, 1600 yards upstream from Kirkville Sampled in 1972, 1973, 1975, and 1977.	38-54-28	121-48-27
ELS081	Sacramento River 250 yds upstr from Howells Landing Sampled in 1972, 1973, 1975, and 1977.	38-55-53	121-50-05
ELS815	Sacramento River at Cranmore 1250 yds downstr from Steiner Bend Sampled in 1972, 1973, 1975, and 1977.	38-59-22	121-48-13
ELS082	Sacramento River 1000 yards upstream from Wilson shoaling area Sampled in 1972, 1973, 1975, and 1977.	39-02-28	121-49-59
ELS825	Sac R about 1000 yds downstr of Grimes Station added in 1977.	39-04-15	121-52-52
ELS083	Sac R 600 yds downstr from Ogden Bend Sampled in 1972, 1973, 1975, and 1977.	39-07-07	121-54-30
ELS084	Sac R 2500 yds upstr from Moons Bend 1200 yds upstr from N. end of Yoneda to Butte Slough shoaling area Sampled in 1972, 1973, 1975, and 1977.	39-11-30	121-57-26
ELS085	Sacramento River 1700 yards downstream from Hamilton Bend midway along shore of Winter Island Sampled in 1972, 1973, 1975, and 1977.	39-16-19	122-00-19
ELS035	San Joaquin R at light 2 near Point Beenar. Sampled 1966 - 1977, except 1974.	38-01-45	121-49-52
ELS037	San Joaquin River 500 yards upstream of light 8 west of West Island Sampled 1966 - 1977, except 1974.	38-01-23	121-47-50
ELS039	San Joaquin River at light 10, eastern	38-01-42	121-45-50

	tip of West Island Sampled 1966 - 1977, except 1974.		
ELS041	San Joaquin River 600 yards upstream from light 17 Sampled 1966 - 1977, except 1974.	38-01-45	121-43-50
ELS043	San Joaquin River at light 21 Sampled 1966 - 1977, except 1974.	38-02-43	121-41-47
ELS045	San Joaquin River upstream from mouth of False River Sampled 1966 - 1977, except 1974.	38-03-52	121-40-40
ELS047	San Joaquin River upstream of light 29 Sampled 1966 - 1977, except 1974.	38-05-28	121-40-48
ELS049	San Joaquin River downstream of light 35 opposite Fishermans Cut	38-05-15	121-38-45
ELS051	San Joaquin River bet lights 38 and 39 Sampled 1966 - 1977, except 1974.	38-06-00	121-37-40
ELS053	San Joaquin River 500 yards upstream from light 42 Sampled 1966 - 1977, except 1974.	38-06-00	121-35-42
ELS055	San Joaquin R opposite Potato Slough Sampled 1966 - 1977, except 1974.	38-04-55	121-34-15
ELS057	San Joaquin R opposite Prisoners Point Sampled 1966 - 1977, except 1974.	38-03-40	121-33-32
ELS059	San Joaquin River midway bet Mandeville Point and Buoy 3 Sampled 1966 - 1977, except 1974.	38-03-35	121-32-00
ELS906	San Joaquin River bet lights 5 and 6 at Medford Island Station added in 1985.	38-03-27	121-30-45
ELS909	San Joaquin R from Headreach cutoff upstream. Station added in 1985.	38-01-33	121-28-05
ELS032	Cache Slough at light 40 in center of ship channel at power cables Sampled 1966 - 1977, except 1974.	38-01-33	121-28-05
ELS070	Georgiana Slough 600 yards south of	38-14-00	121-31-10

	Sacramento River Intersection Sampled in 1972, 1973, 1975, and 1977.		
ELS606	West end of Montezuma Slough between two cable crossing zones Station added in 1985.	38-10-12	122-01-24
ELS607	Montezuma Slough east of bridge span west of Cross Slough in confluence Station added in 1985.	38-11-08	121-58-05
ELS609	Montezuma Slough at junction with Nurse Slough opposite West Winds Duck Club Station added in 1985.	38-10-04	121-56-16
ELS067	Montezuma Slough 1600 yards south of Meins Landing. Sampled in 1975.	38-07-40	121-54-52
ELS068	Montezuma Slough 1000 yards south of Roaring River Slough. Sampled in 1975.	38-05-00	121-53-00
ELS092	Coney Island, west Canal side at middle of island. Sampled in 1972.	37-50-27	121-33-21
ELS093	Middle River - NE side of Woodward Island. Sampled in 1972.	37-55-55	121-31-37
ELS094	Middle River - SE corner of Victoria Isl near canal at last dock above bridge. Sampled in 1972.	37-53-48	121-29-35
ELS090	Old River opp. Woodward Isl about 1/2 mile S. of Santa Fe Railroad bridge at landing. Sampled in 1972.	37-55-52	121-33-20
ELS091	Old River at North-South midpoint of Victoria Island, at 2nd set of pipes below the bridge Sampled in 1972.	37-52-59	121-34-21
ELS835	Sac R about 1220 yards above Meridian Station added in 1977.	39-09-24	121-55-31
ELS033	San Joaquin River midway along shore of Winter Island. Sampled 1966-1977, except 1974.	38-03-10	121-50-40

ANALYTICAL METHODS

In the laboratory eggs and larvae are sorted from debris. All eggs are identified to species and counted, and striped bass eggs are classified as 0-8 hours old, 9-36 hours old, or dead. Fish larvae are classified to family or, in some cases, to species, and striped bass larvae are measured to the nearest millimeter standard length. Gut contents of feeding bass larvae are identified to the lowest possible taxon. Since 1984 samples of the earbones (otoliths) were examined to determine the approximate age of the larval bass. Zooplankton are identified to genus and, in some cases, to species. Chlorophyll *a* and pheopigment concentrations were determined with a UV spectrophotometer.

QUALITY ASSURANCE TESTING AND REPORTING

A portion of the samples are processed twice to check the completeness of the sorting and the accuracy of the identifications and measurements. After identification, both bass larva and zooplankton are stored for future reference.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Research Triangle Park, North Carolina

Hardware: IBM mainframe

Volume of Data: Approximately 166,000 observations are on STORET.

Contact for Data Retrieval:

Name: Phil Daniels
Address: State Water Resources Control Board
Phone: (916) 322-4514
Data Availability Date: The data from 1968-1977 has been recently revised in STORET.

REFERENCES

CDFG. 1987. "Striped bass population trends and environmental relationships." DFG Exhibit #25 submitted in the State Hearings, available from the Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA, 95205.

CDFG. 1988. Striped bass egg and larva monitoring and effects of flow regulation on the larval striped bass food chains in the Sacramento-San Joaquin Estuary.

Prepared for the State Water Resources Control Board. Available from the Department of Fish and GAme, 4001 N. Wilson Way, Stockton, CA 95205.
Low, A.F., and L.W. Miller. 1986. 1984 striped bass egg and larva survey in the Sacramento-San Joaquin Estuary. Technical report 11 prepared for the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary.

~**Descriptors:** bay-delta; plankton/algae/seagrass; water diversion; biological resources; fisheries; abundance; distribution; hydrology and flow; shrimp; reproduction; primary production; food chains; larval mortality; larval growth; cdfg;

GENERAL INFORMATION AND ABSTRACT

Program: Midwater Trawl Survey

Funding Agency: California Department of Fish and Game

Principal Investigator: Lee W. Miller
California Department of Fish and Game
(209) 466-4421

Conducting Agency: Department of Fish and Game

Period of Record, Earliest Date: 1967 (Not continuous, samples were not collected in 1974 or 1979).

Period of Record, Latest Date: Present

Geographic Boundaries Description: South San Francisco Bay, north to San Pablo Bay, east through the Carquinez Straits, up the Sacramento River to Rio Vista, the San Joaquin River to Empire Tract, and south to Clifton Court Forebay.

ABSTRACT

Monitoring of the striped bass population has been conducted by the California Department of Fish and Game (DFG) since the Central Valley Project began in the mid-1950's, in recognition of the probable adverse effects of water diversion on this valuable fishery. This program was expanded, as part of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, when the State Water Project pumps began operating in the Delta in the late 1960's. The general objective of the program is to determine factors responsible for annual fluctuations in the numbers of juveniles as estimated by an index of their abundance at 38mm, and how the abundance at that stage affects numbers of fish eventually entering the fishery. Abundance indices of several life stages (eggs and larvae, juvenile, and adult) are computed. Statistical relationships between the abundance indices themselves or between the indices and measured environmental variables are assessed. These statistical relationships indicate factors that may control the distribution and abundance of striped bass and that may deserve additional study.

An immense amount of data has been collected under this program. Different facets of the program have been separated in the Estuarine Data Index, as even the individual facets comprise large datasets in their own right. For more information on monitoring of the striped bass fishery please refer to other DFG

studies entitled "Striped Bass Egg and Larva Survey" and "Striped Bass Summer Tow Net Study".

The midwater trawl survey provides a third index of young of the year striped bass abundance in the lower Sacramento and San Joaquin Rivers (in addition to the egg and larva survey and the summer tow net survey) of striped bass abundance in the lower Sacramento and San Joaquin Rivers. Monthly midwater trawl indices are usually in the range of 100 to 6,000. Although monthly indices vary, the total index can be compared to the index obtained by the summer tow net survey to evaluate survival. The 1989 index of 431 was the lowest index ever obtained. In comparison the indices for 1986, 1987 and 1988 were 3960, 1350 and 498 respectively.

PARAMETERS

Media Analyzed: Water.

BIOLOGICAL PARAMETERS MEASURED

striped bass abundance and length

PHYSICAL PARAMETERS MEASURED

electrical conductivity
water transparency
water temperature

TAXA

Morone saxatilis	striped bass

METHODS

SAMPLING METHODS

The midwater trawl is conducted once each month from September through December at about 100 sites in the upper estuary. The midwater trawl surveys are designed to index bass abundance during the fall when they range in size from about 50- 150 mm. Sample sites and methods are standardized so that abundance indices can be calculated. Diagonal tows with 12X12 square foot midwater trawl net are used in sample collection.

SAMPLING FREQUENCY AND LOCATION

Number of stations: The total number of stations sampled is approximately 165.

Beginning in 1967, monthly surveys were conducted from September to March. However,in recent years, one survey per month has been conducted from September to December since 1967. Sampling stations in San Francisco Bay were dropped when the San Francisco Bay study began. Sampling currently takes place from San Pablo Bay to Rio Vista on the Sacramento River and Stockton on the San Joaquin River.

MWT902	Holland Cut just S. of the North tip of Holland Tract. Sampled since 1967.	38-01-40	121-34-58
MWT104	South San Francisco Bay ship channel near light 8. Sampled since 1968.	37-36-20	122-17-05
MWT112	South San Francisco Bay 1600 yards E of Rincon Point. Sampled since 1968.	37-47-09	122-21-40
MWT111	South San Francisco Bay 2700 yards E Potrero Point. Sampled from 1968 to 1973, and 1975-1978 only.	37-45-15	122-21-03
MWT110	South San Francisco Bay 1100 yards NE of Point Avisadero. Sampled from 1968 to 1973, and 1975-1978 only.	37-44-00	122-20-43
MWT109	South San Francisco Bay about 1700 yards SE of Hunters Point. Sampled from 1968 to 1973, and 1975-1978 only.	37-42-42	122-20-22
MWT108	South San Francisco Bay ship channel S of light 2. Sampled from 1968-1973, and 1975-1978 only.	37-41-30	122-20-20
MWT102	South San Francisco Bay near Dolphin E of Oyster Point channel. Sampled from 1968-1973, and 1975-1978 only.	37-41-37	122-18-47
MWT101	South San Francisco Bay 1500 yards E o light 4. Sampled 1968-1973, and 1975 to 1978.	37-40-45	122-18-45
MWT107	South San Francisco Bay ship channel at light 4. Sampled 1968-1973, and 1975 to 1978.	37-40-05	122-19-34
MWT106	South San Francisco Bay at light 6 Sampled 1968-1973, and 1975 to 1978.	37-38-45	122-18-50

MWT105	South San Francisco Bay ship channel midway between lights 6 and 8. Sampled 1968-1973, and 1975-1978.	37-37-28	122-18-04
MWT103	South San Francisco Bay 1300 yards N of San Mateo Bridge ship channel. Sampled 1968-1973, and 1975-1978.	37-35-25	122-15-35
MWT917	Midpoint of Victoria Canal Established in 1967, dropped in recent years.	37-52-27	121-31-18
MWT202	North San Francisco Bay 1300 yards SW Point Knox on Angel Island. Sampled 1968-1973 and 1975-1978.	37-50-50	122-26-50
MWT203	Richardson Bay N of light 2 Sampled 1968-1973, and 1975-1978.	37-51-28	122-28-11
MWT414	Suisun Bay NNW of light 2, NE of Boom Sampled since 1967.	38-03-13	122-06-45
MWT415	Suisun Bay 1100 yards SW of light 4 near reserve fleet. Sampled since 1967.	38-03-30	122-06-15
MWT416	Suisun Bay 550 yards N of light 4 near reserve fleet. Sampled since 1967.	38-04-06	122-05-34
MWT417	Suisun Bay at light 6 near re fleet. Sampled since 1967.	38-04-51	122-04-36
MWT418	Suisun Bay SW of light 8 Sampled since 1967.	38-05-35	122-04-15
MWT419	Suisun Bay SW of light 9. Established in 1967. Sampled infrequently.	38-06-15	122-03-30
MWT604	Grizzly Bay 1000 yards E of light 10, at Montezuma Slough. Established in 1967.	38-07-25	122-03-15
MWT603	Grizzly Bay 2500 yards NW at 10 from Garnet Point on Ryer Island. Established in 1967.	38-06-48	122-02-30
MWT602	Grizzly Bay 2500 yards NE at 20 from Garnet Point on Ryer Island.	38-06-58	122-01-50

	Established in 1967.		
MWT601	Grizzly Bay 1300 yards NE at 30 from Garnet Point on Ryer Island. Established in 1967.	38-06-12	122-02-00
MWT515	Suisun Cutoff 550 yards at 150 from Point Buckler. Established in 1967.	38-05-28	122-00-50
MWT516	Suisun Bay 300 yards W of west end of Freeman Island. Established in 1967.	38-04-35	121-59-32
MWT517	Suisun Bay 700 yards S of east end of Freeman Island. Established in 1967.	38-04-10	121-58-40
MWT518	Honker Bay 1100 yards S of mouth of Champion Slough. Established in 1967.	38-04-08	121-57-20
MWT519	Honker Bay 2200 yards N of Simmons point. Established in 1967.	38-04-25	121-56-00
MWT205	N San Francisco Bay 500 yards E of Treasure Island docks. Established in 1968.	37-49-40	122-21-30
MWT206	N San Francisco Bay-Berkeley flats 2700 yards NE of Treasure Island. Sampled 1968-1973, and 1975-1978.	37-50-38	122-20-28
MWT207	N San Francisco Bay 2200 yards N of Berkeley Pier midpoint. Sampled 1968-1973, and 1975-1978.	37-52-12	122-20-42
MWT113	S San Francisco Bay 2400 yards E of Sierra Point. Sampled 1968-1973, and 1975-1978.	37-40-45	122-21-30
MWT316	San Pablo Bay at Petaluma Channel light 6. Established 1970, infrequently sampled in recent years.	38-04-00	122-25-37
MWT319	San Pablo Bay at marker #8 in the Petaluma Boat channel. Established in 1970, sampled infrequently in recent years.	38-04-39	122-25-54

MWT313	San Pablo Bay 2200 yards NE of Rat Rock Established in 1970, sampled infrequently in recent years.	38-01-20	122-26-58
MWT318	San Pablo Bay N of light #1, S of Petaluma Boat Channel. Established in 1970.	38-03-00	122-25-50
MWT330	San Pablo Bay NE from Petaluma boat channel light 2. Established in 1970, sampled infrequently since 1979.	38-03-07	122-24-50
MWT331	San Pablo Bay 3300 yards NE of Petalu light 2. Established in 1970, sampled infrequently since 1979.	38-03-55	122-23-38
MWT332	San Pablo Bay 5200 yards NE of Petaluma channel light 2. Established in 1970, sampled infrequently since 1979.	38-04-24	122-23-30
MWT333	San Pablo Bay 3700 yards N of ship channel light 9. Established in 1970, sampled infrequently since 1979.	38-04-23	122-21-24
MWT334	San Pablo Bay 3000 yards N of ship channel light 11. Established in 1970, sampled infrequently since 1979.	38-04-35	122-20-15
MWT335	San Pablo Bay 2700 yards NW of Rockwall on flats. Established in 1970, sampled infrequently since 1979.	38-04-16	122-19-25
MWT317	San Pablo Bay flats 960 yards N of Point San Pedro, opposite "ruins". Established in 1970, infrequently sampled in recent years.	37-59-54	122-26-55
MWT304	San Pablo Bay 500 yards N of the Sisters. Established in 1970.	37-59-45	122-26-10
MWT307	San Pablo Bay 2500 yards NE of Sister NW of station 306. Established in 1970.	38-00-16	122-25-13
MWT312	San Pablo Bay 2200 yards NE of Sisters toward Petaluma ship channel. Established in 1970, not sampled	38-00-43	122-25-56

	regularly.		
MWT314	San Pablo Bay midway between markers BW "E" and Petaluma channel light 1. Established in 1970.	38-01-40	122-24-45
MWT315	San Pablo Bay 2200 yards WNW of Petaluma channel lights 1 and 2, opposite Point Pinole. Established in 1970.	38-02-32	122-23-30
MWT327	San Pablo Bay 1600 yards NW of ship channel light 9. Established in 1970.	38-02-54	122-21-50
MWT328	San Pablo Bay about 1900 yards NW of channel light 11. Established in 1967.	38-03-37	122-21-00
MWT329	San Pablo Bay 800 yards N of ship channel light 13. Established in 1970.	38-03-49	122-18-15
MWT302	San Pablo bay 950 yards NW of Point Pinole. Established in 1970.	38-00-50	122-22-30
MWT322	San Pablo Bay 1500 yards NE of Point Pinole. Established in 1970.	38-01-28	122-21-00
MWT323	San Pablo Bay 2200 yards SE of ship channel light 10. Established in 1967.	38-01-45	122-19-40
MWT320	San Pablo Bay flats 2000 yards NW of Hercules. Established in 1967, sampled infrequently in recent years.	38-01-25	122-18-18
MWT326	San Pablo Bay 2200 yards NW of Rodeo on a line between Davis and Pinole Points. Established in 1970.	38-02-23	122-17-45
MWT901	False River 1 K east of San Joaquin River junction. Established in 1967, not sampled in recent years.	38-03-24	121-40-00
MWT906	Middle River at Junction with Three River Reach 100 yards W of Medford Island. Established in 1967.	38-02-20	121-31-27
MWT913	Middle River off SW end of Mildred Island. Established in 1967, sampled	37-58-25	121-32-11

	infrequently in recent years.		
MWT914	Middle River at SE corner of Bacon Island at tower. Established in 1967, sampled infrequently in recent years.	37-56-40	121-31-55
MWT903	N fork of the Mokelumne River, 1600 yards upstream from junction with the San Joaquin River. Established in 1967.	38-06-25	121-34-15
MWT340	Napa River - Mare Island above fixed bridge. Established in 1970. Prior to 1980, sampled from below bridge.	38-07-33	122-16-55
MWT915	Old River along E side of Fay Island W side of Bacon Island. Established in 1970, sampled infrequently in recent years.	37-56-32	121-33-32
MWT916	Old River at Swing Bridge at Victoria Island. Established in 1967, not sampled in recent years.	37-52-45	121-34-30
MWT918	Old River NW of Coney Island Established in 1967, infrequently sampled in recent years.	37-51-40	121-34-05
MWT201	N San Francisco Bay between Alcatraz Island and San Francisco. Established in 1968. Not sampled since 1978.	37-49-07	122-25-17
MWT204	N San Francisco Bay 600 yards NW of R "2" light NW of Treasure Island. Established in 1968, not sampled since 1978.	37-50-03	122-23-47
MWT208	N San Francisco Bay 1800 yards E of Angel Island. Established in 1968, not sampled since 1978.	37-51-55	122-23-55
MWT209	N San Francisco Bay 1600 yards NE of Bluff Point on Tiburon Peninsula. Established in 1968, not sampled since 1978.	37-53-23	122-25-20
MWT210	N San Francisco Bay about 1400 yards	37-55-17	122-26-24

	of Red Rock. Established in 1967, not sampled since 1978.		
MWT211	N San Francisco Bay W of ship channel north of San Rafael Bridge. Established in 1968, not sampled since 1978.	37-56-25	122-26-45
MWT303	San Pablo bay N of light 2 at Point San Pablo. Established in 1970,	37-58-20	122-25-39
MWT301	San Pablo Bay 800 yards NE of Point San Pablo. Established in 1970.	37-58-40	122-22-25
MWT305	San Pablo Bay 1500 yards NE of light opposite the Sisters. Established in 1967.	37-59-42	122-24-32
MWT306	San Pablo Bay 1300 yards SW of Buoy BW "E" in middle of ship channel. Established in 1970.	38-00-05	122-24-50
MWT308	San Pablo Bay 960 yards NW of Buoy BW "E" in the ship channel. Established in 1970.	38-00-55	122-24-17
MWT309	San Pablo Bay just NE of Buoy BW "E" in ship channel. Established in 1970.	38-00-52	122-23-43
MWT311	San Pablo Bay 1500 yards NW of Point Pinole. Established in 1970.	38-01-15	122-22-42
MWT310	San Pablo Bay 1100 yards SW of channel light 7 and 8. Established in 1970.	38-01-40	122-22-32
MWT321	San Pablo bay ship channel ENE of lights 7 and 8. Established in 1967.	38-02-04	122-21-45
MWT324	San Pablo Bay E of ship channel lights 11 and 12. Established in 1967.	38-03-10	122-19-13
MWT325	San Pablo Bay 900 yards E of channel lights 13 and 14. Established in 1970, not sampled in recent years.	38-03-25	122-177-35
MWT336	San Pablo Bay along N side of the	38-03-45	122-16-40

	channel near Rockwall, E of light 15. Established in 1970.		
MWT337	San Pablo Bay opposite Rockwall, E of channel light 15. Established in 1970.	38-03-35	122-16-35
MWT339	San Pablo Bay along Rockwall 1900 yards E of channel light 15. Established in 1970.	38-04-00	122-15-35
MWT338	San Pablo Bay N of Carquinez Strait opposite Napa River channel. Established in 1967.	38-03-46	122-15-00
MWT401	Carquinez Strait along C&H sugar plan dock E of Bridge. Established in 1970.	38-03-34	122-12-50
MWT402	Carquinez Strait E of Dillon Point Established in 1970. No longer sampled.	38-03-27	122-11-06
MWT404	Carquinez Strait inshore near Port Costa E light 22. Established in 1970.	38-02-46	122-10-37
MWT403	Carquinez Strait at edge of flats N channel W of light 23. Established in 1970.	38-02-48	122-10-10
MWT405	Carquinez Strait E of light 23 Established in 1967.	38-02-08	122-09-20
MWT406	Carquinez Strait E of Ozol Dock about 900 yards SE of light 25. Established in 1970.	38-01-43	122-09-10
MWT407	Carquinez Strait midchannel 1600 yards E of light 23. Established in 1970.	38-02-04	122-08-32
MWT408	Carquinez Strait channel 1000 yards downstream from Benicia Bridge. Established in 1970. Often not sampled on fast flood tide.	38-02-01	122-07-45
MWT409	Suisun Bay 850 yards upstream from San Pablo RR bridge, near light 6.	38-02-40	122-06-25

	Established in 1967.		
MWT410	Suisun Bay 2400 yards upstream of San Pablo Bridge at light 7, 400 yards W of Avon pier. Established in 1967.	38-02-55	122-05-40
MWT411	Suisun Bay 700 yards upstream from light 10, just W of Point Edith.	38-03-34	122-04-10
MWT412	Suisun Bay between lights 11 and 12 Established in 1967.	38-03-50	122-03-25
MWT413	Suisun Bay 400 yards upstream from light 14. Established in 1967.	38-03-57	122-02-35
MWT501	Suisun Bay downstream from light 17 Established in 1967.	38-03-47	122-01-35
MWT502	Suisun Bay downstream from light 19 Established in 1967.	38-03-37	122-00-17
MWT503	Suisun Bay downstream from light 21 Opposite middle point. Established in 1967.	38-03-38	121-59-10
MWT504	Suisun Bay upstream of light 22 Established in 1967.	38-03-34	121-58-23
MWT505	Suisun Bay 500 yards upstream from lights 24 and 25. Established in 1967.	38-03-27	121-57-28
MWT506	Suisun Bay 500 yards N of Stake Point Established in 1967.	38-03-15	121-56-40
MWT507	Suisun Bay at light 27 off Simmons Point on Chipps Island. Established in 1967.	38-03-03	121-56-10
MWT508	Suisun Bay 500 yards N of light 28 Established in 1967.	38-03-45	121-54-40
MWT509	Suisun bay 1200 yards upstream from light 28 off Chipps Island. Established in 1967.	38-03-47	121-54-00
MWT510	Suisun Bay opposite light 30 in ship	38-03-53	121-53-35

	channel opposite light 30, off Se corner of Chipps Island at mouth of Spoonbill Creek. Established in 1967.		
MWT511	Suisun Bay upstream from light 31 off Vansickle Island. Est. in 1967	38-03-05	121-53-00
MWT512	Sacramento River 1000 yards upstream from light 31, 300 yards off Vansickle Island. Est. 1967.	38-03-20	121-52-32
MWT513	Sacramento River off Vansickle Is at light 34. Est. 1967.	38-03-43	121-51-55
MWT514	Sacramento River upstream from light just N of ship channel. Est. 1967.	38-03-56	121-50-40
MWT701	Sacramento River at lights 5 and 6 in center of ship channel. Est. 1967.	38-03-51	121-49-45
MWT702	Sacramento River downstream of lights 7 and 8 in center of ship channel. Established in 1967.	38-03-42	121-48-50
MWT703	Sacramento River upstream of lights 9 and 10. Established in 1967.	38-03-42	121-47-50
MWT704	Sacramento River 1300 yards upstr lights 11 and 12. Established in 1967.	38-04-19	121-46-35
MWT705	Sacramento River 500 yards upstream lights 13 and 14. Established in 1967.	38-04-55	121-45-23
MWT706	Sacramento River upstream of lights 15 and 16. Opposite S tip of Decker Island. Established in 1967.	38-05-30	121-44-20
MWT707	Sacramento River upstream of lights 19 and 20. Upstream from N tip of Decker Island. Established in 1967.	38-06-55	121-42-25
MWT708	Sacramento River upstream from light 23. Established in 1967	38-07-45	121-41-40
MWT709	Sacramento River downstream of lights	38-08-52	121-41-22

	27 and 28. Established in 1967.		
MWT710	Sacramento River upstream of the Rio Vista Bridge. Established in 1967.	38-09-50	121-40-47
MWT711	Sacramento River 600 yards upstream from light 36 in ship channel. Est. 1967.	38-10-30	121-40-15
MWT717	Lower Sacramento River at Grand Island below Isleton. Established in 1967.	38-10-15	121-37-55
MWT801	San Joaquin River at Broad Slough 500 yards S of Sacramento River light 2. Established in 1967. Sampled infrequently.	38-03-20	121-50-50
MWT802	San Joaquin River 500 yards N of Point Beenar along 20 ft contour off E side of Winter Island. Established in 1967.	38-02-13	121-50-15
MWT803	San Joaquin River upstream from Antioch Point opposite Kimball Island. Est. in 1967; station not sampled in recent years.	38-01-29	121-49-18
MWT804	San Joaquin River 600 yards upstream from light 8 in center of ship channel. Established in 1967.	38-01-22	121-47-47
MWT805	San Joaquin River 500 yards downstream from light 11 in center of ship channel N of West Island. Established in 1967.	38-01-38	121-46-25
MWT806	San Joaquin River 500 yards upstream from light 11 in center of ship channel. Established in 1967.	38-01-42	121-45-27
MWT807	San Joaquin River 600 yards upstream from light 17. Established in 1967.	38-01-50	121-43-50
MWT808	San Joaquin River 200 yards upstream of Blind Point. Established in 1967.	38-02-05	121-42-45
MWT809	San Joaquin River near light 24 at	38-03-24	121-41-17

	Jersey Point. Established in 1967.		
MWT810	San Joaquin River 500 yards upstream from light 26, 200 yards W of Bradford Island. Established in 1967.	38-04-20	121-40-29
MWT811	San Joaquin River upstream from light 33. Established in 1967.	38-05-45	121-39-45
MWT812	San Joaquin River upstream from light 34 opposite Fisherman's Cut. Est. 1967.	38-05-15	121-38-57
MWT813	San Joaquin River upstream of light 38 off Twitchell Island. Est. 1967.	38-06-12	121-37-40
MWT814	San Joaquin River downstream from light 42, north of Webb Tract. Est. 1967.	38-06-10	121-36-15
MWT815	San Joaquin River at junction with Mokelumne River. Est. 1967.	38-05-48	121-34-47
MWT904	San Joaquin River upstream from light 53 opposite mouth of Old River. Est. 1967.	38-04-45	121-34-03
MWT905	San Joaquin River upstream of Prisoners Point at light 57. Established 1967.	38-03-40	121-33-25
MWT906	San Joaquin River between lights 5 and 6 in the center of the ship channel. Established in 1967.	38-03-27	121-30-45
MWT909	San Joaquin River 300 yards NW of light 18 in center of ship channel. Established in 1967.	38-01-33	121-28-05
MWT910	San Joaquin River East of S tip of Spud Island in center of ship channel. Established in 1967.	38-00-00	121-26-47
MWT911	San Joaquin River 500 yards upstream from lights 33 and 34. Established in 1967.	37-59-30	121-24-15
MWT912	San Joaquin River near mouth of Calaveras River. Established in 1967.	37-57-55	121-21-58

MWT713	Cache Slough N of light 43.	38-12-20	121-39-30
MWT715	Cache Slough N of light 47.	38-13-20	121-40-20
MWT907	Little Connection Slough 600 yards S of junction with Potato Slough. Est 1967, sampled infrequently.	38-03-45	121-30-00
MWT919	Little Potato Slough 1200 yards N junction with White Slough at Strawberry Landing. Established 1967. Sampled infrequently.	38-06-12	121-29-27
MWT605	W end of Montezuma Slough 1700 yards upstream of mouth. Established 1967.	38-08-50	122-03-25
MWT606	W end of Montezuma Slough 3 miles mouth at overhead power cables. Established in 1967.	38-10-12	122-01-24
MWT607	Montezuma Slough 850 yards downstream from Cross Slough. Established in 1967.	38-11-08	121-58-05
MWT609	Montezuma Slough at junction with Cross Slough. Established in 1967. Not usually sampled.	38-10-04	121-56-16
MWT610	Montezuma Slough at top of bend downstream from Birds Landing. Est 1967, not usually sampled.	38-07-32	121-53-20
MWT608	Montezuma Slough at E end of Roaring River Slough. Established in 1967.	38-05-30	121-53-05
MWT520	New York Slough 500 yards upstrea from light 3 in center of channel. Est in 1967. Sampled irregularly.	38-02-05	121-52-20

ANALYTICAL METHODS

Mean catches are calculated for large segments of the estuary and then multiplied by water volumes in each segment. The monthly index is the sum of these products. The sum of the monthly indices is the annual abundance index.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Research Triangle Park, North Carolina
Hardware: IBM mainframe
Software: STORET
STORET Agency Code: 21Cal-82
Volume of Data: 157,000 records

Contact for Data Retrieval

Name: Phil Daniels
State Water Resources Control Board

Phone: (916) 322-4514

Data Availability Date: 1967-1985 data is available now.

REFERENCES

Brown, R.L. 1987. 1985-1986 report of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary. Prepared for the Interagency Ecological Studies Group. Available from the Department of Water Resources. Sacramento, CA.

Stevens, D.E., and L.W. Miller. 1983. Effects of river flow on abundance of young Chinook Salmon, American Shad, Longfin Smelt, and Delta Smelt in the Sacramento-San Joaquin River System. North American Journal of Fisheries Management 3: 425-437.

~**Descriptors:** bay-delta; water diversion; delta outflow; abundance; fisheries; biological resources; hydrology and flow; distribution; north delta; east delta; west delta; south delta; suisun bay; cdfg;

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Stevens, D.E., and L.W. Miller. 1983. Effects of river flow on abundance of young Chinook Salmon, American Shad, Longfin Smelt, and Delta Smelt in the Sacramento-San Joaquin River System. North American Journal of Fisheries Management 3: 425-437.

~**Descriptors:** bay-delta; water diversion; delta outflow; abundance; fisheries; biological resources; hydrology and flow; distribution; north delta; east delta; west delta; south delta; suisun bay; cdfg;

GENERAL INFORMATION AND ABSTRACT

Program:	Striped Bass Summer Tow Net Study
Funding Agency:	Department of Fish and Game
Principal Investigator:	Lee W. Miller Department of Fish And Game (209) 466-4421
Conducting Agency:	Department of Fish and Game
Period of Record, Earliest Date:	1959
Period of Record, Latest Date:	Present (continuous, with the exception of 1966 and 1983)
Geographic Boundaries Description:	Samples are collected between San Pablo Bay, Rio Vista on the Sacramento River, Stockton, and Clifton Court.

ABSTRACT

Monitoring of the striped bass (*Morone saxatilis*) population has been conducted by the California Department of Fish and Game (DFG) since the Central Valley Project began in the mid-1950's, in recognition of the probable adverse effects of water diversion on this valuable fishery. This program was expanded, as part of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, when the State Water Project pumps began operating in the Delta in the late 1960's. The general objective of the program is to determine factors responsible for annual fluctuations in the numbers of juveniles as estimated by an index of their abundance at 38 mm, and how the abundance at that stage affects numbers of fish eventually entering the fishery. Abundance indices of several life stages (eggs and larvae, juvenile, and adult) are computed. Statistical relationships between the abundance indices themselves or between the indices and measured environmental variables are assessed. These statistical relationships indicate factors that may control the distribution and abundance of striped bass and that may deserve additional study.

An immense amount of data has been collected under this program. Different facets of the program have been separated in this index, as even the individual facets comprise large datasets in their own right. For more information on monitoring of the striped bass fishery please refer to other DFG studies entitled "Striped Bass Egg and Larva Survey" and "Midwater Trawl Study".

GENERAL INFORMATION AND ABSTRACT

Program:	Diked Baylands Wildlife Study
Funding Agency:	U.S. Fish and Wildlife Service
Principal Investigator:	Jini Scammell-Tinling (916) 978-4613 U.S. Fish and Wildlife Service
Conducting Agency:	U.S. Fish and Wildlife Service
Period of Record, Earliest Date:	October 1982
Period of Record, Latest Date:	Present (through September 1989)
Geographic Boundaries Description:	Observations are made throughout the North and South Bay.

ABSTRACT

The Diked Baylands Wildlife Study is a collection of baseline information on wildlife use of diked seasonal wetlands on North and South San Francisco Bay. There are 146 study sites within the Counties of Alameda, Marin, Santa Clara, Solano, and Sonoma. Most of the North Bay sites are in agricultural use (i.e., production of small grains like oats and hay, or used for pasture).

Due to the low elevations of these diked lands and their clay soils which characteristically shrink and swell, depressions form in which water ponds during the rainy season. The extent of ponding depends on the efficiency of each site's drainage and pumping capabilities and the amount of rainfall.

Study results document use of diked seasonal wetlands as wintering habitat for many species of migratory waterfowl and shorebirds of the Pacific Flyway. These lands also provide year- round habitat for other waterbirds, migratory songbirds, raptors, upland game birds and terrestrial wildlife. In general, study results show that numbers of waterbirds supported on diked seasonal wetlands are directly proportional to the extent of on-site ponding. Data collection began in October 1982 and concluded in September 1989.

year to year due to changing environmental conditions in the estuary, it generally ends from mid-July to early August.

Field sampling occurs every second week at about 30 sites in the major nursery areas. At each sampling site a diagonal 10 minute tow is made against the current at a standardized boat speed. The striped bass catch is preserved in the field, while other species of fish are measured and released. Striped bass are transported to the laboratory where stomachs are dissected and contents analyzed for food habit studies. Since 1989 otoliths have been removed and analyzed for age-length studies.

SAMPLING FREQUENCY AND LOCATION

Number of Sampling Sites: A total of 49 stations have been sampled since the inception of the program in 1959. Some stations have been dropped over the years; 32 stations are currently sampled.

Samples are collected every second week from late June to late July or early August, primarily in the Delta and Suisun Bay. Station numbers are listed at the end of the site description.

	Latitude	Longitude
TNS501 Suisun Bay between Roe and Ryer Islands	38-04-24	122-02-20
TNS418 Suisun Bay near surplus ships, opposite the Avon oil docks	38-04-06	122-05-34
TNS602 Grizzly Bay NE of Suisun Slough at Dolphin	38-07-07	122-02-30
TNS519 Honker Bay, Western end at Dolphin	38-04-26	121-56-00
TNS312 San Pablo Bay 2200 yards NE of Sisters toward Petaluma	38-00-43	122-25-56
TNS315 San Pablo Bay 2200 yards WNW of Petaluma lights 1 and 2	38-02-32	122-23-30
TNS328 San Pablo Bay about 1900 yards NW of ship channel light	38-03-37	122-21-00
TNS329 San Pablo Bay 800 yards N of ship channel light 13	38-03-49	122-18-15

CDFG. 1987. "Striped bass population trends and environmental relationships." DFG Exhibit #25 submitted in the State Hearings, available from the Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA, 95205. 149 pages.

Stevens, D.E., D.W. Kohlhorst, L.W. Miller, and D.W. Kelley. 1985. The decline of striped bass in the Sacramento-San Joaquin estuary, California. Transactions of the American Fisheries Society 114: 12-30.

~**Descriptors:** bay-delta; fisheries; biological resources; abundance; salinity; reproduction; cdfg;

TNS704	Sacramento River on N side across from Sherman Lake, under downstream towers	38-03-55	121-47-14
TNS706	Sacramento River below south tip of Decker Island, under PG&E towers	38-05-30	121-44-15
TNS707	Sacramento River at 3 Mile Slough in channel from lights 19 - 21	38-06-53	121-42-20
TNS11	Sacramento R at tip of Grand Isl from red buoy into river along Grand Island	38-10-37	121-39-40
TNS801	San Joaquin River 1 km upstream of the mouth	38-03-09	121-50-37
TNS804	San Joaquin River SW tip of West Island in south channel	38-01-02	121-47-39
TNS809	San Joaquin River N channel opposite Jersey Point under PG&E towers	38-03-24	121-41-17
TNS812	San Joaquin River just W of Boulton Pt in channel north of Santa Clara shoals	38-05-30	121-38-43
TNS815	San Joaquin River at mouth of Potato Slough between lights 49 and 51	38-04-55	121-34-22
TNS906	San Joaquin River at Medford Island between lights 8 and 10	38-03-00	121-30-15
TNS910	San Joaquin River between Hog and Turner Cut, starting at light 21	38-00-00	121-26-47
TNS912	San Joaquin River at mouth of Calaveras River at light 41	37-57-55	121-21-58
TNS713	Cache Slough north of light 43	38-12-20	121-39-30
TNS919	Little Potato Slough 1/2 mile east of Terminous	38-06-25	121-29-55
TNS606	Montezuma Slough off Joice Island at PG&E cable crossing	38-10-12	122-01-50
TNS609	Montezuma Slough at Nurse Slough starting on S bank at West Winds Duck	38-10-05	121-56-15

PARAMETERS

BIOLOGICAL PARAMETERS MEASURED
species abundance of waterbird, raptor, songbirds, upland game birds and miscellaneous other wildlife

MISCELLANEOUS PARAMETERS
percent ponding on site
species activity (resting, feeding, foraging, hunting, passing through or over, heard only, nesting)
vegetative characteristics of site

TAXA

Accipiter cooperii	Cooper's hawk
Accipiter striatus	sharp-shinned hawk
Actitis macularia	spotted sandpiper
Aechmophorus occidentalis	western and/or Clark's grebe
Aeronautes saxatalis	white-throated swift
Agelaius phoeniceus	red-winged blackbird
Agelaius tricolor	tricolored balckbird
Aimophila ruficeps	rufous-crowned sparrow
Aix sponsa	wood duck
Ammodramus savannarum	grasshopper sparrow
Amphispiza belli	sage sparrow
Anas acuta	northern pintail
Anas americana	American wigeon
Anas clypeata	northern shoveler
Anas crecca	green-winged teal
Anas cyanoptera	cinnamon teal
Anas discors	blue-winged teal
Anas penelope	Eurasian wigeon
Anas platyrhynchos	mallard
Anas strepera	gadwall
Anthus spinoletta	water pipit
Anser albifrons	greater white-fronted goose
Aphelocoma coerulescens	scrub jay
Aquila chrysaetos	golden eagle
Archilochus alexandri	black-chinned hummingbird
Ardea herocias	great blue heron
Arenaria interpres	ruddy turnstone
Arenaria melanocephala	black turnstone
Asio flammeus	short-eared owl
Athene cunicularia	burrowing owl
Aythya affinis	lesser scaup
Aythya americana	redhead

Aythya collaris	ring-necked duck
Aythya marila	greater scaup
Aythya valisineria	canvasback
Bombycilla cedrorum	cedar waxwing
Botaurus lentiginosus	American bittern
Branta canadensis	Canada goose
Bubo virginianus	great horned owl
Bubulcus ibis	cattle egret
Bucephala albeola	bufflehead
Bucephala clangula	common goldeneye
Bucephala islandica	Barrow's goldeneye
Buteo jamaicensis	red-tailed hawk
Buteo lagopus	rough-legged hawk
Buteo lineatus	red-shouldered hawk
Buteo regalis	ferruginous hawk
Buteo swainsoni	Swainson's hawk
Butorides striatus	green-backed heron
Calidris alpina	dunlin
Calidris canutus	red knot
Calidris mauri	western sandpiper
Calidris minutilla	least sandpiper
Callipepla californica	California quail
Calypte anna	Anna's hummingbird
Carduelis pinus	pine siskin
Cardeulis psaltria	lesser goldfinch
Cardeulis tristis	American goldfinch
Carpodacus mexicanus	house finch
Carpodacus purpureus	purple finch
Casmerodius albus	great egret
Cathartes aura	turkey vulture
Catharus guttatus	hermit thrush
Catoptropherus semipalmatus	willet
Certhia americana	brown creeper
Ceryle alcyon	belted kingfisher
Charadrius alexandrinus [nivosus]	snowy plover [western]
Chaetura vauxi	Vaux's swift
Chamea fasciata	wrentit
Charadrius semipalmatus	semipalmated plover
Charadrius vociferus	killdeer
Chen caerulescens	snow goose
Chen rossii	Ross' goose
Chondestes grammacus	lark sparrow
Chordeiles minor	common nighthawk
Circus cyaneus	northern harrier
Cistothorus palustris	marsh wren

Colaptes auratus	northern flicker
Columba fasciata	band-tailed pigeon
Columba livia	rock dove
Contopus borealis	olive-sided flycatcher
Contopus sordidulus	western wood-pewee
Corvus brachyrhynchos	American crow
Corvus corax	common raven
Cyanocitta stelleri	Steller's jay
Cygnus columbianus	tundra swan
Dendrocygna bicolor	fulvous whistling duck
Dendroica coronata	yellow-rumped warbler
Dendroica nigrescens	black-throated gray warbler
Dendroica occidentalis	hermit warbler
Dendroica petechia	yellow warbler
Dendroica townsendi	Townsend's warbler
Dolichonyx oryzivorus	bobolink
Egretta thula	snowy egret
Elanus caeruleus	black-shouldered kite
Empidonax difficilis	western flycatcher
Empidonax traillii	willow flycatcher
Eremophila alpestris	horned lark
Euphagus cyanocephalus	Brewer's blackbird
Falco columbarius	merlin
Falco mexicanus	prairie falcon
Falco peregrinus [anatum]	peregrine falcon [American]
Falco sparverius	American kestrel
Fulica americana	American coot
Gallinago gallinago	common snipe
Gallinula chloropus	common moorhen
Gavia arctica	Artic loon
Gavia immer	common loon
Gavia stellata	red-throated loon
Geothlypis trichas [sinuosa]	common yellowthroat [salt Marsh]
Grus canadensis	sandhill crane
Heteroscelus incanus	wandering tatler
Himantopus mexicanus	black-necked stilt
Hirundo pyrrhonta	cliff swallow
Hirundo rustica	barn swallow
Icteria virens	yellow-breasted chat
Icterus galbula	northern oriole
Ixoreus naevius	varied thrush
Junco hyemalis	dark-eyed junco
Lanius ludovicianus	loggerhead shrike
Larus argentatus	herring gull
Larus californicus	California gull

Larus canus	mew gull
Larus delawarensis	ring-billed gull
Larus glaucescens	glaucous-winged gull
Larus occidentalis	western gull
Larus philadelphia	Bonaparte's gull
Larus thayeri	Thayer's gull
Laterallus jamaicensis [Coturniculus]	black rail [California]
Limnodromus griseus	short-billed dowitcher
Limnodromus scolopaceus	long-billed dowitcher
Limosa fedoa	marbled godwit
Lophodytes cucullatus	hooded merganser
Melanerpes formicivorus	acorn woodpecker
Melanerpes lewis	Lewis' woodpecker
Melanitta perspicillata	surf scoter
Melospiza lincolnii	*Lincoln's sparrow*
Melospiza melodia	song sparrow
Mergus merganser	common merganser
Mergus serrator	red-breasted merganser
Mimus polyglottos	northern mockingbird
Molothrus ater	brown-headed cowbird
Myiarchus cinerascens	ash-throated flycatcher
Numenius americanus	long-billed curlew
Numenius phaeopus	whimbrel
Nycticorax nycticorax	black-crowned night heron
Oporornis tolmiei	MacGillivray's warbler
Oreoscoptes montanus	sage thrasher
Otus kennicottii	western screech-owl
Oxyura jamaicensis	ruddy duck
Pandion haliaetus	osprey
Parus inornatus	plain titmouse
Parus rufescens	chestnut-backed chickadee
Passer domesticus	house sparrow
Passerella iliaca	fox sparrow
Passerculus sandwichensis	Savannah sparrow
Passerina amoena	Lazuli bunting
Pelecanus erythrorhynchos	American white pelican
Pelecanus occidentalis [Californicus]	brown pelican [California]
Phalacrocorax auritus	double-crested cormorant
Phalaenoptilus nuttallii	common poorwill
Phalaropus fulicaria	red phalarope
Phalaropus lobatus	red-necked phalarope
Phalaropus tricolor	Wilson's phalarope
Phasianus colchicus	ring-necked pheasant
Pheucticus melanocephalus	black-headed grosbeak
Pica nuttalli	yellow-billed magpie

Picoides nuttalli	Nuttall's woodpecker
Picoides pubescens	downy woodpecker
Picoides scalaris	ladder-backed woodpecker
Picoides villosus	hairy woodpecker
Pipilo erythrophthalmus	rufous-sided towhee
Pipilo fuscus	brown towhee
Piranga ludoviciana	western tanager
Pluvialis dominica	lesser golden plover
Pluvialis squatarola	black-bellied plover
Podiceps auritus	horned grebe
Podiceps grisegena	red-necked grebe
Podiceps nigricollis	eared grebe
Podilymbus podiceps	pied-billed grebe
Polioptila caerulea	blue-gray gnatcatcher
Pooecetes gramineus	vesper sparrow
Porzana carolina	sora
Psaltriparus minimus	bushtit
Rallus limicola	Virginia rail
Rallus longirostris [obsoletus]	clapper rail [California]
Recurvirostra americana	American avocet
Regulus calendula	ruby-crowned kinglet
Regulus satrapa	golden-crowned kinglet
Salpinctes obsoletus	rock wren
Sayornis nigricans	black phoebe
Sayornis saya	Say's phoebe
Selasphorus rufus	Rufous hummingbird
Selasphorus sasin	Allen's hummingbird
Sialia mexicana	western bluebird
Sitta carolinensis	white-breasted nuthatch
Sphyrapicus ruber	red-breasted sapsucker
Spizella passerina	chipping sparrow
Stelgidopteryx serripennis	northern rough-winged swallow
Sterna antillarum [browni]	least tern [California]
Sterna caspia	Caspian tern
Sterna elegans	elegant tern
Sterna forsteri	Forster's tern
Sturnella neglecta	western meadowlark
Sturnus vulgaris	European starling
Tachycineta bicolor	tree swallow
Tachycineta thalassina	violet-green swallow
Thryomanes bewickii	Bewick's wren
Tringa flavipes	lesser yellowlegs
Tringa melanoleuca	greater yellowlegs
Tringa solitaria	solitary sandpiper
Troglodytes aedon	house wren

Troglodytes troglodytes	winter wren
Turdus migratorius	American robin
Tyrannus verticalis	western kingbird
Tyto alba	common barn-owl
Vermivora celata	orange-crowned warbler
Vireo gilvus	warbling vireo
Vireo huttoni	Hutton's vireo
Vireo solitarius	solitary vireo
Wilsonia pusilla	Wilson's warbler
Xanthocephalus xanthocephalus	yellow-headed balckbird
Zenaida macroura	mourning dove
Zonotrichia albicollis	white-throated sparrow
Zonotrichia atricapilla	golden-crowned sparrow
Zonotrichia leucophrys	white-crowned sparrow

METHODS

SAMPLING METHODS

Both ground and aerial surveys were performed in this study. Ground surveys were conducted by walking around the entire site or making observations from selected vantage points. Aerial transects of study sites followed the ground surveys to assure complete coverage.

SAMPLING FREQUENCY AND LOCATION

Number of Stations: There are 146 study sites.

Wildlife census data were collected on study sites within Alameda, Marin, Napa, San Mateo, Santa Clara, Sonoma and Solano Counties. Aerial censuses were conducted during the winter rainfall season. Thirteen aerial censuses were conducted between December 1982 and March 1986. Ground censuses were conducted twice a month between the November through April period and once a month between May through October (1982 - 1989).

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location:	U.S. Fish and Wildlife Service, Sacramento CA
Hardware:	Compaq 386
Software:	dBase 3+
Volume of Data:	over 67,000 records to date

Quality Assurance: Prior to data entry, data sheets are reviewed by a biologist. Further error-trapping is accomplished by data entry operators and customized data entry programs.

Contact for Data Retrieval

Name: Jini Scammell-Tinling

Address: U.S. Fish and Wildlife Service
Division of Ecological Services
2800 Cottage Way, Room E-1803
Sacramento CA 95825

Phone: (916) 978-4613

Data Availablity Date:
Data will become available when the study has been completed.

Map Information

Availability: Included in final report.

Level of detail: Maps will show boundaries of study sites. The report will include acreages of study sites.

Contact: Jini Scammell-Tinling (916) 978-4613
U.S. Fish and Wildlife Service

REFERENCES

No reports have been published to date.

~**Descriptors**: bay-delta; north bay; south bay; wetlands; biological resources; birds; endangered species; mammal; san pablo bay; abundance; species diversity; shorebirds; waterfowl; wetland ecology; water birds; dabbling ducks; diving ducks; herons; usfws;

GENERAL INFORMATION AND ABSTRACT

Program:	National Wetlands Inventory / Habitat Mapping of San Francisco Bay
Funding Agency:	U.S. Fish and Wildlife Service Environmental Protection Agency
Principal Investigator:	Lawrence Handley
Conducting Agency:	U.S. Fish and Wildlife Service
Period of Record, Earliest Date:	1956
Period of Record, Latest Date:	1985
Geographic Boundaries Description:	Wetlands around the entire United States and its territories are being mapped; thus all of San Francisco Bay and the Delta are included. In addition to the basic mapping, a special study of distribution trends in the Bay covered both the North and South Bays, with particular emphasis on the latter.

ABSTRACT

In 1974, the US Fish and Wildlife Service initiated the development of an inventory of the wetlands of the United States and its territories. The National Wetland Inventory (NWI) has established a wetland data base in map form to be used in identifying the current status and future trends in distribution of US wetlands. The NWI was intended to provide accurate information to be used in making resource decisions and to foster wise use of US wetlands. NWI maps are widely used by regulatory agencies, developers, and private industry, especially in impact assessments of site-specific development projects. A variety of map products are available to the general public. The NWI has also made possible the evaluation of the effectiveness of wetland protection on a national scale. The NWI has employed a wetland classification scheme developed by the USFWS (Cowardin *et al.* 1979) to provide standardized, detailed identifications of a diversity of habitats across the country. Some of the general findings of the NWI are presented in Tiner (1984).

In 1984 the US Environmental Protection Agency and the US Fish and Wildlife Service (USFWS) provided funds for a USFWS study specifically examining habitat change in the lands surrounding San Francisco Bay. NWI maps were incorporated into a computerized geographic information system (GIS) at the USFWS National

Wetlands Research Center in Slidell, LA. Two sets of data were included in this analysis: black and white aerial photography from 1956; and color infrared, high altitude photographs taken by the National Aeronautics and Space Administration in 1985. These efforts will allow detailed evaluation of changes in wetland acreage in the Bay Area. No formal report discussing these data has yet been published.

PARAMETERS

MISCELLANEOUS PARAMETERS

Wetland ecosystems are classified by system/subsystem/class, as follows:

- Marine
  - subtidal
    - rock bottom
    - unconsolidated bottom
    - aquatic bed
    - reef
  - intertidal
    - aquatic bed
    - reef
    - rocky shore
    - unconsolidated shore
- Estuarine
  - subtital
    - rock bottom
    - unconsolidated bottom
    - aquatic bed
    - reef
  - intertidal
    - aquatic bed
    - reef
    - streambed
    - rocky shore
    - unconsolidated shore
    - emergent wetland
    - scrub-shrub wetland
    - forested wetland
- Riverine
  - tidal
    - rock bottom
    - unconsolidated bottom
    - aquatic bed
    - rocky shore
    - unconsolidated shore
    - emergent wetland
  - lower perennial

rock bottom
unconsolidated bottom
aquatic bed
rocky shore
unconsolidated shore
emergent wetland
upper perennial
rock bottom
unconsolidated bottom
aquatic bed
rocky shore
unconsolidated shore
intermittent
streambed
Lacustrine
limnetic
rock bottom
unconsolidated bottom
aquatic bed
littoral
rock bottom
unconsolidated bottom
aquatic bed
rocky shore
unconsolidated shore
emergent wetland
Palustrine
rock bottom
unconsolidated bottom
aquatic bed
unconsolidated shore
moss-lichen wetland
emergent wetland
scrub-shrub wetland
forested wetland

Classes are further divided into subclasses as follows:

aquatic bed
algal
aquatic moss
rooted vascular
floating vascular
unknown submergent
unknown surface
emergent wetland
persistent

nonpersistent
forested wetland
dead
deciduous or evergreen
broad or needle leaved
open water
unknown bottom
reef
coral
worm
mollusc
rock bottom
bedrock
rubble
rocky shore
bedrock
rubble
scrub/shrub
dead
deciduous or evergreen
broad or needle leaved
streambed
bedrock
rubble
cobble/gravel
sand
mud
organic
vegetated
tidal
bedrock
rubble
unconsolidated bottom
cobble/gravel
sand
mud
organic
unconsolidated shore
cobble/gravel
sand
mud
organic
vegetated

METHODS

ANALYTICAL METHODS

NWI maps are prepared by stereoscopic analysis of high altitude aerial photographs. Wetlands are identified and classified from the photographs based on vegetation, visible hydrology, and geography, using the US Fish and Wildlife Service classification scheme (Cowardin *et al.* 1979).

The mapping of wetland habitats in lower San Francisco Bay involved two sets of aerial photographs that differed widely in scales and emulsions. The earliest photography was black and white from 1956 and 1958 at a scale of 1:24,000. The second set were high altitude, color infrared photographs with a scale of 1:65,000 taken in April 1983 by the National Aeronautics and Space Administration.

Interpreted photography was used to produce 7.5 minute mylar maps. The maps were then digitized and incorporated into a geographic information system known as the Map Overlay and Statistical System (MOSS).

QUALITY ASSURANCE TESTING AND REPORTING

Errors were detected at several steps in the process of digitizing the aerial photography for the San Francisco Bay habitat mapping project. Photointerpreted maps were verified in the field on three separate occasions. Incorrectly labeled and improperly drawn polygons were detected when the interpreted photography was digitized. Digitized data were subsequently plotted and compared with the original habitat maps to detect errors. Remaining errors were uncovered by those conducting analyses of the maps and associated data. The digitized maps then underwent a rigorous peer-review for accuracy. The maps were peer-reviewed twice, first by 25 reviewers and then by 20.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: National Wetlands Research Center, Slidell, LA

Hardware: Data General minicomputer

Software: Data input employs the Analytical Mapping System (AMS); Data analysis is done on the Map Overlay and Statistical System (MOSS). Data output is performed on the Cartographic Output System (COS).

Volume of Data: The maps and associated information on San Francisco Bay alone require approximately 25 megabytes of storage.

Quality Assurance: The maps that were digitized in Slidell underwent a rigorous review for accuracy. After Photointerpretation the maps were verified in the field on 3 separate occasions. The maps were peer-reviewed twice, first by 25 reviewers,

and then once more by 20 reviewers. Errors were also screened in the process of digitizing and analyzing the data. These maps exceed the USGS standards for accuracy.

Contact for Data Retrieval

Name: Larry Handley
U.S. Fish and Wildlife Service
Address: National Wetlands Research Center
1010 Gause Boulevard
Slidell LA 70458
Phone: (504) 646-7359

Map information

Availability: A composite map of wetlands from the South Bay to Suisun Bay will be available in March of 1989. **Subject Description:** A special study of San Francisco's North and South Bays, with emphasis on the latter, was funded by the EPA and the USFWS, and conducted in cooperation with the US Fish and Wildlife Service. For the South Bay, 18 maps (1:24,000 scale) based on USGS quadrangles were produced from color infrared and black and white photography. The earliest photographs date from May, June, and September of 1956, and July, 1958. The most recent maps were produced from 1985 National Aeronautics Space Administration color infrared, high altitude photographs, taken at a scale of 1:65,000. These photographs were supplemented with color infrared National High Altitude Photography Program photographs (1:58,000 scale) taken in 1982-83. The mapped area extends from points near the cities of Berkeley and Sausalito, south to Milpitas and Mountain View, and west to the coast.

For the North Bay phase of the project 24 maps at 1:24,000 scale based on USGS quadrangles were produced from color infrared photographs taken in April 1985. The mapped area extends from points near Point Reyes and Stinson Beach to Rio Vista and Bethel Island.

Level of detail: The minimum mapping unit is one acre for each of the large scale 1:24,000 maps. The minimum size of wetlands mapped ranges from three to five acres, although smaller features, particularly small ponds, may be shown.

Type: Interpreted photographic overlays were composited on 1:24,000 scale USGS topographic quads to produce a standard National Wetlands Inventory habitat map. These resulting maps have been digitized by the National Wetlands Research Center of the US Fish and Wildlife Service.

Contact: For general information, or to order NWI materials contact:
Ben Harrison
U.S. Fish and Wildlife Service
Lloyd 500 Building Suite 1692

500 NE Multnomah Street
Portland OR 97232
(503) 231-6154
FTS 429-6154
OR
Larry Handley
U.S. Fish and Wildlife Service
National Wetlands Research Center
1010 Gause Boulevard
Slidell LA 70458
(504) 646-7359
FTS 680-7359

REFERENCES

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, U.S. Department of the Interior. Washington, D.C. 131 pages.

Handley, L.R. and M.L. Quammen. 1987. Wetland trend analyses for lower San Francisco Bay. U.S. Fish and Wildlife Service, National Wetlands Research Center, Slidell, LA. 17 pages.

Josselyn, M. Evaluation of the habitat functioning for a wetland mitigation site and a natural wetland in San Francisco Bay. Due out mid 1989. For more information, contact Larry Handley, USFWS, Slidell, LA (504) 646-7359.

Leipner, J. and J. Myers. "Wetlands and land-use classification using high altitude thematic mapper simulator data. Science and Application Aircraft Division, NASA, Ames Research Center, Moffett Field, Ca.

USFWS. "Map User's Guide". Due out early 1989. Data from the South Bay from 1956 to 1985 will be one one map; and the South Bay, North Bay and Suisun Marsh data from 1985 will be on another. Contact Larry Handley, USFWS, Slidell, LA. (504) 646- 7359.

~**Descriptors:** wetlands; bay-delta; development; mapping and other inventories; south bay; central bay; san pablo bay; suisun bay; mudflat; delta; suisun marsh; upper drainage; usfws;

GENERAL INFORMATION AND ABSTRACT

Program:	Project Tracking System
Funding Agency:	San Francisco Bay Conservation and Development Commission
Principal Investigator:	Alan Pendleton (415) 557-3686 San Francisco Bay Conservation and Development Commission
Conducting Agency:	San Francisco Bay Conservation and Development Commission
Project Cost:	$5,000
Period of Record, Earliest Date:	1969
Period of Record, Latest Date:	Present
Geographic Boundaries Description:	The San Francisco Bay Conservation and Development Commission collects information on development projects occurring throughout San Francisco Bay and Suisun Marsh.

ABSTRACT

The San Francisco Bay Conservation and Development Commission (BCDC) collects information regarding dredging, filling, and development projects in San Francisco Bay, its shoreline, the Suisun Marsh, and diked historic baylands. Data on file for individual projects includes ownership, location, site characteristics, permit status, related environmental documents, amounts of dredge and fill, and other information. These data have been collected since 1967. Data from 1986 onward are being entered onto a newly adopted computer system called the Project Tracking System (PTS).

PARAMETERS

MISCELLANEOUS PARAMETERS

applicant and co-applicant information
application summary dates
- received
- filing decision

- filed
- notice given
- hearing
- recommendation due

approval/comments
assessor parcel number
cease and desist details
Corps of Engineers project number
current owner
dredge information
- amount
- disposal site

enforcement details
environmental documents
fee information
file number
fill details
- gross
- net
- volume
- type
- uses

hearing minutes
interested parties
issues
mitigation information
permit categories
- administrative
- enforcement action
- hearing application
- jurisdictional determination
- environmental document matter

permit recommendations
project analyst
project jurisdictional determinations
project mailing list
project owner
project name
project start dates
- scheduled
- actual

project status
project summary
project uses
public access involved
regulations relied upon for permit
reviews

site description
- acreage
- shoreline length
- areas underwater
- wetlands

special conditions of permit

METHODS

Methods are not applicable to this dataset.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: San Francisco Bay Conservation and Development Commission, San Francisco, California

Hardware: Wang VS 65

Software: PACE with PTS application

Period of Record: Data from 1974 to the present are computerized. Data back to 1965 will be computerized during 1990-1991.

Contact for Data Retrieval:

Name: Alan Pendleton
San Francisco Bay Conservation and Development Commission

Address: 30 Van Ness Avenue Room 2011
San Francisco CA 94102 - 6080

Phone: (415) 557-3686

Access: Most of the information is available to the public.

Data Availability Date: The computerized data is expected to be ready in March 1989.

REFERENCES

BCDC. 1986. Annual report. San Francisco Bay Conservation and Development Commission. San Francisco, CA

BCDC. Monthly status reports. San Francisco Bay Conservation and Development Commission. San Francisco, CA

BCDC. Project Tracking System Manual. San Francisco Bay Conservation and Development Commission. San Francisco, CA

~**Descriptors:** bay-delta; dredging and spoil disposal; development; wetlands; san pablo bay; central bay; south bay; salt ponds; suisun marsh; sediments and dredging; BCDC;

GENERAL INFORMATION AND ABSTRACT

Program:	San Francisco Bay Shoreline Information System
Funding Agency:	San Francisco Foundation/Marin Community Foundation
Principal Investigator:	Bill Davoren
Conducting Agency:	The Bay Institute
Period of Record, Earliest Date:	1985
Period of Record, Latest Date:	1987
Geographic Boundaries Description:	This Marin County database encompasses all parcels of land contiguous to the line of highest tidal action, parcels classified by the USFWS as wetlands, and all undeveloped parcels adjacent to wetlands within the historical margins of the Bay.

ABSTRACT

The San Francisco Bay Shoreline Information System (BAYSIS) is a computerized data management system developed by the Bay Institute as a tool for storing and processing information on shoreline areas and wetlands. This system is intended to facilitate public access to standardized information on the Bay shoreline, so that proposed development and mitigation plans can be evaluated on a systematic basis. Information stored on BAYSIS is grouped by tax assessor's parcels, and includes location, ownership, land use, environmental descriptions (of soils, hydrology, geology, topology, presence of rare or endangered species, wetlands classification, and more), and development status. A trial application of BAYSIS has been completed for the shoreline of Marin County.

Tax assessor's parcel data from 1987 provide a framework for the data stored for Marin County. Included in the analysis are parcels contiguous to the line of highest tidal action of the Bay, parcels encompassing wetlands within the historical margins of Bay marshland, and underwater parcels. Aerial photography from 1985 was used to determine habitat types.

PARAMETERS

MISCELLANEOUS PARAMETERS MEASURED

acreage

archaeological/historical resources
assessed value of parcel
assessor's parcel number
availability of utilities
census tract
current land use
developed and undeveloped acreages
development projects in progress - development name, developer's name and address, development description, list of permits required and permit status
flood plain
flora
general plan designation
geology
hydrology
mitigation bank potential
open space
parcel city
parcel location
parcel owner's name and address
rare or endangered species
seismic data
shoreline access
site elevation
slope range
soils
square footage
tax code area
topography
USGS quadrangle
wetlands classification
zoning

METHODS

SAMPLING FREQUENCY AND LOCATION

The area of study is confined to wetlands in Marin County.

QUALITY ASSURANCE TESTING AND REPORTING

Wetlands status is checked in the field.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: The Bay Institute, Sausalito, California

Hardware: IBM PC

Software: dBase III, PC ARCINFO

Volume of Data: 17 megabytes

Contact for Data Retrieval

Name: Nancy Ferguson

Address: The Bay Institute
Schoonmaker Building #120
10 Liberty Ship Way
Sausalito CA 94965

Phone: (415) 331-1910 or
(415) 331-2303

Data Availability Date: Immediately

REFERENCES

"San Francisco Bay Shoreline Information System." Available from the Bay Institute, Schoonmaker Bldg. #120, 10 Liberty Ship Way, Sausalito, CA, 94965. 11 pages.

~**Descriptors:** bay-delta; development; wetlands; mapping and other inventories; endangered species; biological resources; band-aid; diked historic baylands;

GENERAL INFORMATION AND ABSTRACT

Program:	Transcripts and Lists of Exhibits from the San Francisco Bay/Sacramento-San Joaquin Delta Hearings
Funding Agency:	US Environmental Protection Agency
Principal Investigator:	Tom Tamblyn (916) 445-8841 State Water Resources Control Board
Conducting Agency:	State Water Resources Control Board
Period of Record, Earliest Date:	July, 1987
Period of Record, Latest Date:	Present
Geographic Boundaries Description:	The transcripts and exhibits contain information regarding all of San Francisco Bay and the Delta.

ABSTRACT

The California State Water Resources Control Board is presently conducting evidentiary hearings to set water quality standards for the Bay-Delta estuary and to consider amending water rights to implement these standards. This complex task began in 1987 with the receipt of tremendous quantities of written and oral evidence regarding the beneficial uses of the estuary, factors that affect those uses, and means of implementing water quality objectives. The hearings are continuing in 1988. Verbatim transcripts of oral testimony from the hearings and indices of submitted exhibits have been entered onto a computer system to allow general public access. This information can be accessed from any personal computer with a modem, or from terminals located at Regional Water Quality Control Board offices. Further information on public access is provided in the "Data Storage Information and References" section.

PARAMETERS

TOPICS DISCUSSED DURING PHASE I OF THE BAY-DELTA HEARINGS

Session Number

1 Hydrologic conditions
2 Bay-Delta Estuary uses: municipal and industrial

3 Bay-Delta Estuary uses: agriculture
4 Export uses: municipal and industrial
5 Export uses: agriculture and others
6 Bay-Delta Estuary uses: wildlife
7 Uses upstream of the Estuary
8 Bay-Delta Estuary uses: Chinook salmon
9 Bay-Delta Estuary uses: other migrating and resident fish
10 Bay-Delta Estuary uses: striped bass fishery
11 Pollutants in the Bay-Delta Estuary
12 Impacts of fresh water inflow of San Francisco Bay
13 Bay-Delta Estuary uses: recreational and other uses
14 Program of implementation

METHODS

A methods section is not applicable to this record.

DATA STORAGE INFORMATION AND REFERENCES

Location: Aquatic Habitat Institute, Richmond, CA

Hardware: Microvax II

Software: Info DB+

Volume of Data: Approximately 10 megabytes

Quality Assurance: Verbal testimony was electronically recorded by the court reporter.

Contacts for Data Retrieval

For questions relative to the State Bay-Delta Hearing Testimony and Exhibits Database and/or hearing schedules, procedures and etc.:

Name: Tom Tamblyn
State Water Resources Control Board
P.O. Box 100
Sacramento CA 95801

Phone: (916) 445-8841

For assistance with the AHI-EPA computer system and/or telecommunications problems:

Name: Todd Featherston
SCI Datasystems, Inc.
c/o Aquatic Habitat Inst.
1301 S. 46 St. #180
Richmond CA 94804

Phone: (415) 231-9539

Access: General public access by modem, dial (415) 643-7485.

Data Availability Date:
Immediately

Report Cost: No charge for system use

REFERENCES

SWRCB. 1987. Workplan for the hearing process on the San Francisco Bay/Sacramento-San Joaquin Delta estuary. State Water Resources Control Board, Division of Water Rights. Sacramento, CA.
37 pages.

~**Descriptors:** bay-delta; san francisco bay; delta; suisun bay; suisun marsh. san pablo bay; central bay; south bay; fisheries; birds; invertebrates; plankton/algae/seagrass; endangered species; chlorinated hydrocarbons; other hydrocarbons. other parameters; pesticides; pollutant sources; trace elements; delta outflow; hydrodynamics and modelling; precipitation; water diversion; point sources; urban runoff; riverine inputs; dredging and spoil disposal; atmospheric deposition; spills; benthic infauna; grain size; sediment bioassays; sediment chemistry; effluent testing; sediment testing; wetland ecology; trace elements; pesticides; chlorinated hydrocarbons; other hydrocarbons; pollutant sources; algal blooms; bioaccumulation; nutrients; salinity; chlorinated hydrocarbons; water quality; agricultural drainage; upper drainage; rivers; pollutants and related parameters; biological resources; wetlands; hydrology and flow; sediments and dredging; toxicity testing; delta inflow;

GENERAL INFORMATION AND ABSTRACT

Program:	Segmentation of the San Francisco Bay-Delta
Funding Agency:	Environmental Protection Agency
Principal Investigator:	Andrew Gunther
Conducting Agency:	The Aquatic Habitat Institute
Study Cost:	$8,000
Period of Record, Earliest Date:	November, 1987
Geographic Boundaries Description:	All of San Francisco Bay, including the Sacramento-San Joaquin River Delta.

ABSTRACT

The Aquatic Habitat Institute, under contract with the US Environmental Protection Agency, developed a segmentation scheme for the Bay and Delta. The purpose of this effort was to provide a guide by which contaminant data from different studies can be combined in a consistent manner for statistical analysis of regional or temporal trends. Ultimately, a well-developed segmentation scheme may provide a rational basis for regulatory decisions regarding such issues as treatment levels, mass emission rates, and discharge locations.

This scheme divides the estuary into five major areas: South Bay, Central Bay, San Pablo Bay, Suisun Bay, and the Delta (Gunther 1987). Further subdivisions are made within each of these areas, for a total of 42 segments. These segments can be aggregated at various levels of organization as needed by the user. The scheme was developed by consideration of the following key features of the Bay-Delta environment: depth, hydrology, location of major outfalls, and geography. The scheme is particularly designed for assessment of contaminant distribution. Other segmentation schema were reviewed as well, and are discussed in Gunther (1987). The boundaries and key features of each segment are presented in that report, along with a listing of the latitude and longitude of major point source effluent outfalls.

PARAMETERS

PHYSICAL PARAMETERS ANALYZED

depth

geography
hydrology
location of major outfalls

METHODS

A methods section is not applicable to this study.

DATA STORAGE INFORMATION AND REFERENCES

DATA STORAGE

Location: Aquatic Habitat Institute

Hardware: IBM PC

Software: Numonics

Volume of Data: Approximately 2 megabytes

Quality Assurance: Digital data were entered for small sections of the maps being digitized. Plots were then compared to the originals by printing on translucent paper and overlaying.

Contact for Data Retrieval
Name: Andy Gunther
Aquatic Habitat Institute
Bldg. 180, Richmond Field Station
1301 S. 46th Street
Richmond Ca 94804

Phone: (415) 231-9539

Access: Digitized nautical charts available to the general public in electronic form

Data Availability Date: Immediately

Map Information Availability: Maps of the segmentation scheme are available for the Bay, Delta, or the Bay-Delta combined.

Subject Description: The segmentation scheme provides a guide by which contaminant data from different monitoring programs can be combined in a consistent manner

for statistical analysis of regional or temporal variation.

Level of detail: This map was based on NOAA nautical charts and USGS 7.5 minute quads.

Type: Digitized, and in hard copy.

Cost: Digitized data is available free of charge to those who supply floppy disks

Contact: Andrew Gunther
Aquatic Habitat Institute
180 Richmond Field Station
1301 South 46th Street
Richmond CA 94804
(415) 231-9539

REFERENCES

Gunther, A.J. 1987. Segmentation of the San Francisco Bay-Delta. Aquatic Habitat Institute, Richmond, CA. 22 pages. Report Cost: $10.00

~**Descriptors:** bay-delta; outfalls; point sources; pollutant sources; outfall location; discharge points;

AQUATIC HABITAT INSTITUTE

announces

S I N B A D

the Scientific Information Network for the Bay And Delta

The Aquatic Habitat Institute announces an on-line information system for people interested in the San Francisco Estuary. The system, known as the Scientific Information Network for the Bay And Delta (SINBAD), includes the Estuarine Data Index, the Bay-Delta Hearing Testimony and Exhibits Database, the Bay-Delta Bibliography, and the AHI Bulletin Board. All the information services are menu-driven, keyword searchable, and are available to any interested party at no charge.

THE ESTUARINE DATA INDEX: The first database, known as the Estuarine Data Index, contains detailed summaries of 70 research and monitoring programs that have been, or are presently being, conducted in the San Francisco Estuary. Each summary contains an abstract, and information about methods, and quality assurance procedures. The summaries also list sampling site locations, parameters studied, references, and contains information on data storage, including contact names and telephone numbers. The EDI was recently updated and expanded, and each summary has been verified for accuracy by the principal investigator. This data base was designed to be useful in enhancing coordination and communication between the scientific community, environmental managers, and the public.

THE BAY-DELTA BIBLIOGRAPHY: The second database is the Bay-Delta bibliography. The more than three thousand entries in the database can be searched by author, title, or subject. This database was compiled from in-house publication lists of state and federal agencies, consulting firms, and environmental organizations. In addition, hundreds of recent reports and articles obtained by the Institute have been included, and new documents are added monthly. Many entries have abstracts, and those contained in AHI's noncirculating library include the library call number for easy access.

BAY-DELTA HEARING TESTIMONY: The third data base is the Bay-Delta Hearing Testimony and Exhibits database. The California State Water Resources Control Board is presently conducting evidentiary hearings to set water quality standards for the San Francisco Estuary, and to consider amending water rights to implement these standards. This complex task began in 1987 with the receipt of tremendous quantities of written and oral evidence regarding the beneficial uses of the Estuary, factors that affect those uses, and means of implementing water quality objectives. The Hearing Testimony and Exhibits Database contains verbatim transcripts of the oral testimony given during Phase 1 (and the beginnings of Phase II) of the Bay-Delta Hearings; and a list of the exhibits submitted during the hearings.

AHI ELECTRONIC BULLETIN BOARD: The most recent addition to the system is an electronic "bulletin board". This includes a complete electronic messaging service, allowing all users of the Bay-Delta community to send and receive messages. The Institute will also post lists of recently obtained reports and journal articles relevant to the ecology of the Estuary.

Individuals may access the system at publicly available terminals (locations are listed in Dial-up access instructions) or by using a personal computer and modem. The modem number is (415) 643-7485. Communications software with VT-100 emulation capability (an industry standard) is needed to log onto the system. Dial-up access instructions are attached. Public domain communications software is available from the Aquatic Habitat Institute at (415) 231-9539.

UNIVERSITY OF CALIFORNIA AT BERKELEY

Bioassays for Local Effects Monitoring of Wastewater Discharges	Alex Horne

UNIVERSITY OF CALIFORNIA AT SAN DIEGO

Butyltin Studies	Ed Goldberg

WOODWARD-CLYDE CONSULTANTS/SANTA CLARA VALLEY WATER DISTRICT

Santa Clara Nonpoint Source Study	Peter Mangarella

should be replaced with "8,583-7485". If you are using a State telephone line in the 415 area code use "3-7485". A successful connection is indicated on the screen as 'CONNECT 2400' or 'CONNECT 1200' or 'CONNECT 300'.

Step 4: Once your video terminal or microcomputer is successfully connected to SINBAD press the RETURN key once or twice and the SINBAD will request 'USERNAME:'. If you are a first time user of the system, type "GUEST". If you have previously accessed the system you will have been assigned a USERNAME at that time (see Step 7 explanation). Please use that USERNAME in response to the request.

Step 5: SINBAD will next prompt you with 'PASSWORD:'. If you are a first time user enter "GUEST" as your PASSWORD and then press the RETURN key. If you were given a USERNAME previously, you selected a unique PASSWORD at that time, please enter that PASSWORD in response to the 'PASSWORD' prompt and then press the RETURN key.

AT THIS POINT ALL BUT FIRST TIME USERS ADVANCE TO STEP 9.

Step 6: If you entered "GUEST" in response to the 'USERNAME:' prompt and "GUEST" in response to the 'PASSWORD:' prompt you will be asked for the following information:

FIRST NAME:
LAST NAME:
ORGANIZATION:
STREET ADDRESS:
CITY:
STATE:
ZIP:
PHONE NUMBER:

After each prompt enter the requested information and press the RETURN key. After entering all of the above information the SINBAD will repeat your entries and prompt you to make any necessary changes to them or to press RETURN to continue.

Step 7: Following your verification of the above information, enter what you want your USERNAME to be: it can be any character string from three to eight characters.

Step 8: You will next be prompted to enter a 6 to 12 character long PASSWORD of your choice. You may enter any combination of 6 to 12 letters and/or numbers for your PASSWORD and then press the RETURN key. Both your USERNAME and PASSWORD should be written down at this time so that you may use them in the future to access SINBAD.

UNITED STATES COAST GUARD

U. S. Coast Guard Spills Data	Marine Response Officer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

San Francisco Bay Effluent Toxicity Study	Donald Mount

UNITED STATES FISH AND WILDLIFE SERVICE

Diked Baylands Wildlife Study	Jini Tinling
Interagency Salmon Study Program	Patricia Brandes
Midwinter Waterfowl Survey	Jim Bartonek
National Wetlands Inventory	Larry Handley
Contaminants of Concern: San Francisco Bay and San Pablo Bay National Wildlife Refuges	Jean Takekawa
Toxicant Occurrance and Effects in Water Birds	Harry Ohlendorf
Wildlife Use of Salt Ponds	Jean Takekawa

UNITED STATES GEOLOGICAL SURVEY

Benthic Community Structure	Fred Nichols
Hydrodynamic Monitoring and Modeling	Jeff Gartner
Phytoplankton and Zooplankton Studies	Jim Cloern
Regional Effects Monitoring Program: Benthic Studies	Larry Schemel
Trace Metal Accumulation in Benthos and Sediments	Sam Luoma
Water Resources Data	John Bader
Western San Joaquin Valley Hydrogeologic Studies	Robert Gilliom

TABLE 1

Official Bay-Delta Hearing Exhibit Lodging Locations
with access to the
State Hearing Testimony and Exhibits Database

Address	Contact Person/Phone No.
State Water Resources Control Board Bay-Delta Hearing Record, Room 311 B 901 P Street Sacramento, CA 95814	Tom Tamblyn (916) 445-8841 or ATSS 8-485-8841
U.S. Environmental Protection Agency 75 Hawthorne Street San Francisco, CA 94105	Linda Sunnen (415) 556-6597
Regional Water Quality Control Board Oakland - San Francisco Bay Region (2) 2101 Webster Street, Suite 500 Oakland, CA 94612	Michael Carlin (415) 561-1325
Regional Water Quality Control Board Los Angeles Region (4) 107 South Broadway, Room 4027 Los Angeles, CA 90012-4596	Dennis Dasker (213) 549-5522
Regional Water Quality Control Board Fresno - Central Valley Region (5) 3614 East Ashland Fresno, CA 93726	Betty Yee (209) 445-5116
Regional Water Quality Control Board Redding - Central Valley Region (5) 415 Knollcrest Drive Redding, CA 96002	Jim Pedri (916) 224-4845
Regional Water Quality Control Board Riverside - Santa Ana Region (8) 6809 Indiana Avenue, Suite 200 Riverside, CA 92200	Pat Wong (714) 632-4130
Regional Water Quality Control Board San Diego Region (9) 9771 Clairemont Mesa Boulevard San Diego, CA 92124	Mike McCann (619) 636-5114

Public Access is also available at the Aquatic Habitat Institute in Richmond, CA.

CHEVRON, USA

Chevron Deep Water Outfall Studies	Larry Goodheart
Chevron Equivalent Protection Study	Pete Williams
Chevron Toxicity Reduction Evaluation	Pete Williams

EAST BAY MUNICIPAL UTILITY DISTRICT

Local Effects Monitoring	Tom Selfridge

KINNETIC LABORATORIES/SOUTH BAY DISCHARGERS AUTHORITY

South Bay Dischargers Authority: Biological Studies	Marty Stevenson
South Bay Dischargers Authority: Water Quality	Marty Stevenson

LAWRENCE BERKELEY LABORATORIES

Spatial and Seasonal Variations of Trace Elements in South San Francisco Bay	Donald Girven

LAWRENCE LIVERMORE NATIONAL LABORATORY

Organic Contaminants in Sediments and Starry Flounder	Bob Spies

NATIONAL MARINE FISHERIES SERVICE (NMFS)

National Marine Recreational Fishery Statistics Survey	Marty Golden
South Bay Fish Survey	Don Pearson

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

National Coastal Pollutant Discharge Inventory	Dan Farrow

EDI PROGRAMS AND PRINCIPAL INVESTIGATORS LISTED BY CONDUCTING AGENCY

AQUATIC HABITAT INSTITUTE

NPDES Discharge Monitoring Database	Jay Davis
Segmentation Scheme for SF Bay	Andy Gunther

ASSOCIATION OF BAY AREA GOVERNMENTS

ABAG Urban Runoff Studies	Taras Bursztynsky

THE BAY INSTITUTE

San Francisco Bay Shoreline Information System (BAYSIS)	Bill Davoren

CALIFORNIA DEPARTMENT OF FISH AND GAME

Calif. State Mussel Watch Program	Mike Martin
Delta Outflow Study	Perry Herrgesell
Natural Diversity Database	John Ellison
Neomysis-Zooplankton Study	Jim Orsi
Selenium Verification Study	James White
Striped Bass Egg & Larva	Lee Miller
Striped Bass Health Index Monitoring	Don Stevens
Striped Bass Midwater Trawl	Lee Miller
Striped Bass Summer Tow Net	Lee Miller
Trace Element Concentrations in Seawater and Suspended Particulate Matter	R. Michael Gordon