

# INITIAL DEVELOPMENT OF RIPARIAN AND MARSH VEGETATION ON DREDGED-MATERIAL ISLANDS IN THE SACRAMENTO-SAN JOAQUIN RIVER DELTA, CALIFORNIA<sup>1</sup>

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*Abstract: Natural vegetation establishment and development were monitored for 3 1/2 years on a new, dredged-material island located within the breached levees at Donlon Island in the Sacramento-San Joaquin River Delta. Vegetation measurements and maps prepared annually indicate that marsh and riparian vegetation types have developed rapidly. Topographic data for the island has been overlaid with vegetation data, and the results can be used to select elevations when designing future levees, dredged-material deposition areas, and fish and wildlife habitat enhancements.*

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In 1987, the U.S. Army Corps of Engineers and Port of Stockton completed a project to widen and deepen the Stockton Deep Water Ship Channel. A portion of the dredged-material was deposited in open water using sediment diffusers to control material placement. This recently developed technique was used to create small, exposed islands at two sites in the Sacramento-San Joaquin River Delta. The primary objective for creating these dredged-material islands was to provide wildlife and fisheries habitats. In 1987, we began a monitoring study sponsored by the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service. The study was designed to document vegetation establishment, to relate the results to island elevation and configuration, and to develop design guidelines that could be used by interested parties throughout the Delta to develop marsh and riparian woodland vegetation.

This paper presents our findings through the first 3 1/2 years of vegetation establishment on Donlon Island. Construction of the second site, Venice Cut Island, was completed 18 months after Donlon Island, and vegetation establishment there is considerably behind. Therefore, data for Venice Cut Island are not presented.

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## Study Area

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Donlon Island is located in extreme southwestern Sacramento County approximately 3 km northeast of Antioch at Mile 7 on the San Joaquin River. The island

is roughly triangular and is bounded by abandoned levees that have been breached at several locations.

Prior to modification, the interior of Donlon Island was primarily open water with small scattered clumps of California bulrush (*Scirpus californicus*). The encircling levees were fringed with California bulrush and in a few locations supported a narrow band of riparian vegetation dominated by Fremont cottonwood (*Populus fremontii*) and willows (*Salix* sp.).

The nine small dredged-material islands constructed at Donlon Island in January 1985 ranged in size from 0.7 to 5.3 hectares. We collected data only on the largest of these.

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## Methods

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Standard surveying equipment was used to establish a permanent sampling grid on the study island in March 1987. Topographic surveys using the grid as a reference frame were conducted in April 1987 and April 1988. Measurements of surveyed points were converted to elevations relative to mean water level (MWL) based on measurements collected hourly at Antioch by the California Department of Water Resources.

Vegetation maps were prepared in spring and fall 1987 and spring and summer 1988. Vegetation types were identified visually by gross differences in vegetation structure and plant species composition. Location and extent of each vegetation type were measured relative to the permanent sampling grid.

Quantitative vegetation measurements were collected in June 1988. Sampling was stratified by vegetation type; 24 points were sampled in each of the common types and 5 points in uncommon types. At each sample point, a 1.0 by 1.0 meter sampling frame was placed randomly. All plant species present in the frame were identified and the percent cover estimated.

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## Results and Discussion

Deposition of dredged-material created a roughly circular island of bare sand with scattered stands of California bulrush along the edges. Natural colonization occurred rapidly and resulted in the formation of a relatively distinct zonal vegetation (fig. 1). In 1988, we identified seven vegetation types. Physical characteristics of the two most important species in each vegetation type are presented in table 1.

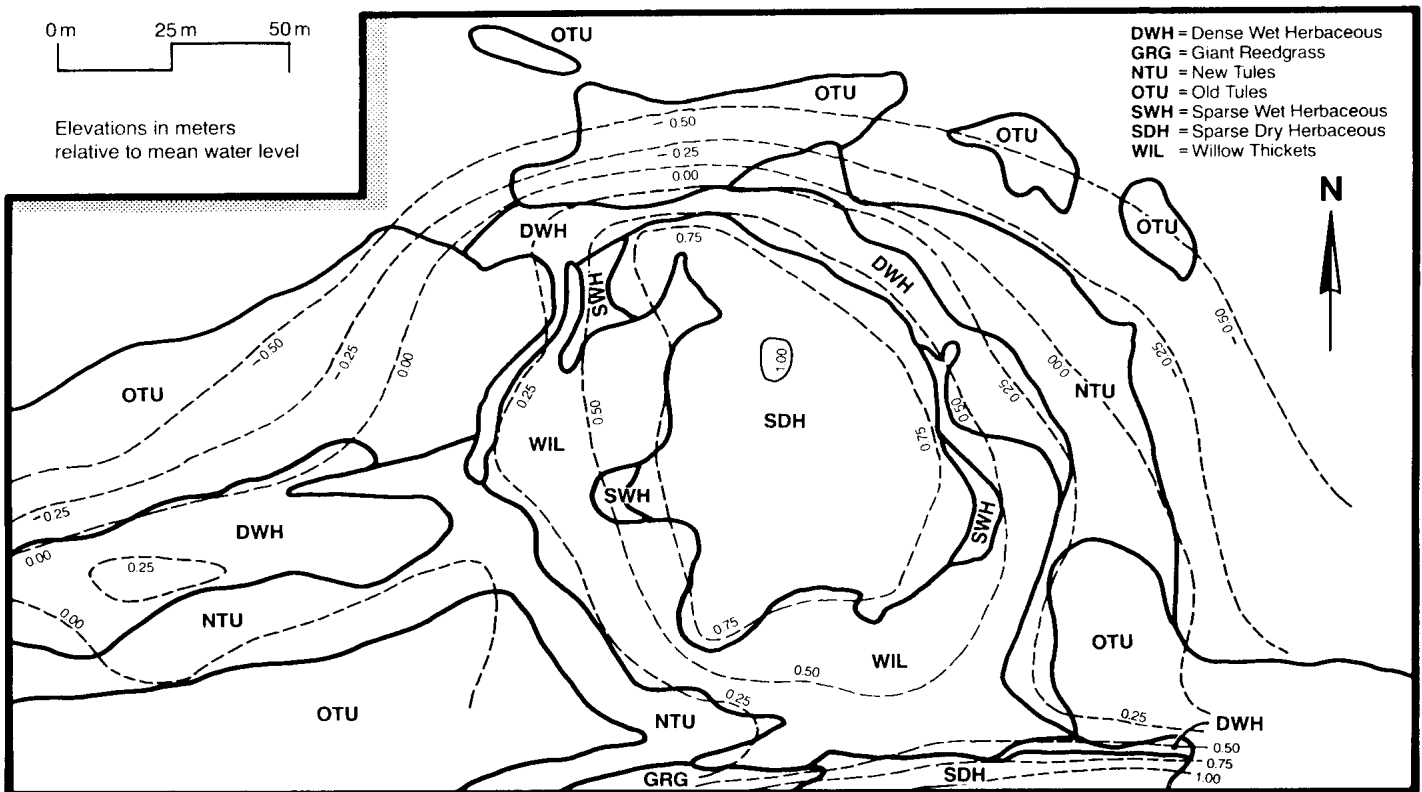
Old Tules (OTU) is vegetation dominated by California bulrush and cattail (*Typha angustifolia* and *T. latifolia*) and was present before the dredged-material island was created. This vegetation is found at the lowest elevations (fig. 1). New Tules (NTU) supports the same species and is becoming established immediately above Old Tules (fig. 1). The extent of both vegetation types has increased over time (table 2).

Dense Wet Herbaceous (DWII) is a vegetation type composed primarily of annuals, biennials, and herbaceous perennials and found at intermediate elevations (fig. 1). The greatest number of species were recorded in this type, and no single species was dominant (table 1). Sparse Wet Herbaceous (SWII) is an uncommon vegetation type (table 2) that is a transition zone be-

tween dry upland sites and lower more moist sites. The area of Dense Wet Herbaceous has remained relatively constant over time (table 2), but the location of the zone has shifted as the lower fringes of Sparse Wet Herbaceous and Sparse Dry Herbaceous have developed into Dense Wet Herbaceous.

Sparse Dry Herbaceous (SDH) occurs at the highest elevations on the island (fig. 1). The ground is relatively barren and dry, and most plant species are annuals. This vegetation is the only type that is above the highest high tides. The extent of this Sparse Dry Herbaceous is decreasing as the lower fringes are being colonized by willows.

Willow Thickets (WIL) are found at intermediate elevations in the same elevation zone as Dense and Sparse Wet Herbaceous and the lower edge of Sparse Dry Herbaceous (fig. 1). The extent of this vegetation is increasing (table 2) as willows, Fremont cottonwood, and white alder (*Alnus rhombifolia*) invade adjacent vegetation types. Young individuals of these species already are present at the upper edges of the Old and New Tules and relatively high in the Sparse Dry Herbaceous zone (fig. 2). Our data suggest that if these tree seedlings survive and grow, willow thickets will become the dominant vegetation type on the island.



**Figure 1**– Topography and vegetation map of study site at Donlon Island in June 1988.

**Table 1** - Percent average cover (AVGCOV), percent frequency of occurrence (FREQ), and importance values (IV) for two most important species found in each vegetation type on Donlon Island in late June 1988.

Vegetation Type <sup>1</sup> /Plant species	Avg.		IV <sup>3</sup>
	Cov. %	Freq <sup>2</sup> %	
Old Tules (N=24) <sup>4</sup>			
California bulrush ( <i>Scirpus californicus</i> )	68.3 (±5.4)	100.0	126.7
Cattail ( <i>Typha</i> sp.)	9.1 (±2.7)	66.7	49.2
New Tules (N=24)			
California bulrush ( <i>Scirpus californicus</i> )	29.1 (±6.6)	91.7	56.1
Cattail ( <i>Typha</i> sp.)	20.1 (±3.9)	87.5	45.1
Dense Wet Herbaceous (N=24)			
Ladythumb smartweed ( <i>Polygonum persicaria</i> )	19.3 (±4.5)	79.2	24.0
Devil's beggartick ( <i>Bidens frondosa</i> )	9.0 (±4.0)	62.5	13.7
Sparse Wet Herbaceous (N=5)			
Cudweed ( <i>Gnaphalium luteo album</i> )	37.0 (±13.3)	100.0	55.0
Water bentgrass ( <i>Agrostis semiverticillata</i> )	23.8 (±13.2)	80.0	37.4
Sparse Dry Herbaceous (N=24)			
Cudweed ( <i>Gnaphalium luteo album</i> )	8.4 (±1.3)	91.7	44.6
Sticky willow herb ( <i>Epilobium watsonii</i> )	4.5 (±0.7)	87.5	30.1
Willow Thicket (N=24)			
Willow ( <i>Salix</i> sp.)	48.5 (±5.0)	95.8	45.6
Davy's centaury ( <i>Centaurium davyi</i> )	13.0 (±3.3)	62.5	15.7
Giant Reed Grass (N=5)			
Giant reed ( <i>Arundo donax</i> )	65.0 (±9.9)	100.0	61.3

<sup>1</sup> Vegetation types described in text.

<sup>2</sup> Frequency = percentage of sample quadrats (1 m<sup>2</sup>) with species present.

<sup>3</sup> Importance value=(relative frequency + relative cover)\*100%; maximum IV=200

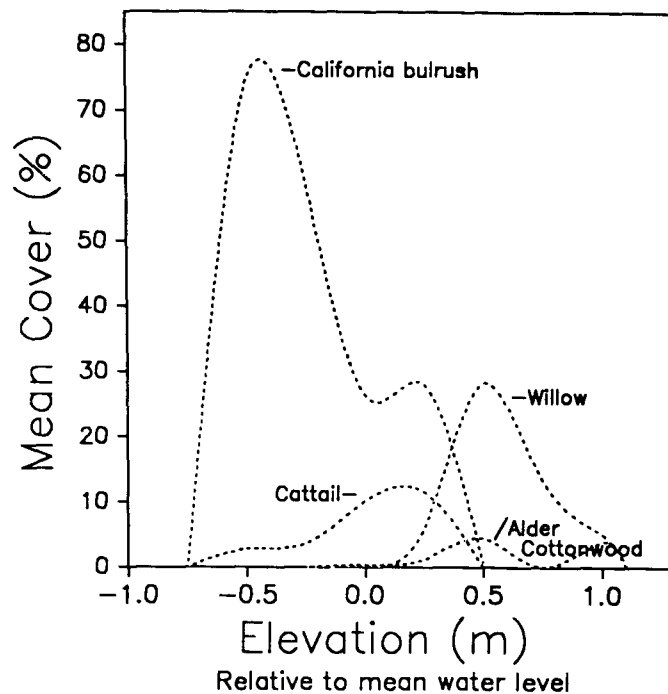
<sup>4</sup> N = number of quadrats sampled in each vegetation type.

**Table 2** -Temporal development of vegetation types on Donlon Island.

Date	Vegetation Type <sup>1</sup> (hectares)							Total
	OTU	NTU	DWH	SWH	SDH	WIL	GRG	
Winter 1985	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Spring 1987	1.0	0.4	0.3	0.3	0.7	0.4	0.0	3.1
Fall 1987	1.2	0.6	0.5	0.1	0.6	0.4	0.0	3.4
Spring 1988	1.3	0.6	0.5	<0.1	0.6	0.5	<0.1	3.5
Summer 1988	1.4	0.6	0.5	<0.1	0.5	0.6	<0.1	3.6

<sup>1</sup> Vegetation types described in text.

Giant Reed Grass (GRG) has established a small foothold at one site (fig. 1). This noxious weed has invaded from the adjoining levee and may be spreading (table 2).



**Figure 2**- Distribution of perennial marsh and riparian woodland plant species on Donlon Island in June 1988, three and one half years after creation of the island.

## Conclusions

Riparian and marsh vegetation is developing rapidly on the study site at Donlon Island. Our data suggest that the island may eventually consist of a band of tules and cattails from approximately -0.25 meters below to 0.50 meters above MWL. Riparian vegetation dominated by several tree species may develop from approximately 0.25 meters above MWL to at least near the top of the island (1.10 meters above MWL). These data are too early in the establishment process to determine the understory that may eventually be present under the riparian trees. However, at this early stage of development it is evident that valuable wildlife habitat has been created where none previously existed.