Progress Report Division of Boating and Waterways, California Department of Parks and Recreation (DBW) February 2018

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DRAAWP Agencies collaborating with:USDA-ARS, NASA-Ames Research Center; UC Davis-Department of Plant Sciences; UC-Davis Agricultural Issues Center; UC-Davis Department of Land, Air and Water Resources.

Progress to date (July 2014-February 2018)

Implement and Assess Improved Weed Control Methodologies Objective

In 2015, the DBW Aquatic Invasive Species (AIS) Branch controlled a total of 4,447 surface water acres of floating aquatic vegetation (water hyacinth and South American spongeplant). That equates to 1038 treatment applications in 213 sites in the Sacramento-San Joaquin Delta and its tributaries (Delta). The highest number of surface water acres ever treated since the DBW started its chemical treatment in 1992 occurred in 2015. In 2014, for example, DBW treated 2,617 acres. DBW has been successful in keeping water hyacinth under control in the Central and Southern Delta and with some success in regions of the Northern Delta, such as Snug Harbor and the Meadows. However, some locations in the Northern Delta, such as Lost Slough, Hog Slough, and Sycamore Slough, have experienced increased growth of water hyacinth because 1) these regions could not be treated until June 1, and 2) 2,4-D, the faster acting herbicide, could not be used in the northern Delta because of Federal Fishery Agencies requirements of DBW pursuant to the federal Endangered Species Act, and also restrictions imposed by the State Water Resources Control Board for irrigation water.

In 2016, DBW chemically treated 4,296 acres of floating aquatic vegetation. Between late November 2015 until early June of 2016 DBW mechanically removed, through harvesters, over 68,000 cubic yards of water hyacinth from Delta waterways.Mechanical control efforts were spread out over more sites and longer time frames in 2016 than in 2015, and were selected to target ‘nursery sites’ that in the past have led to blockages of critical waterways like the Stockton Waterfront, and Old and Middle Rivers. Site selection was guided by satellite images, and surveys of sites by DBW and ARS to identify key infestations of water hyacint A total of 89,227 cubic yards of plant material were removed in 2016 (46% more than in 2015), covering 55.3 acres.

In 2017, for the first time, DBW carried out mechanical removal operations with special boats, conveyors and backhoes throughout the year, except in May and June (excluded under permit requirements). The total acreage requiring mechanical removal treatment in 2017 was much lower than in 2016, 7.7 acres, involving removal of 12,638 cu yds of material

The total acreage of floating aquatic vegetation treated with herbicides in 2017 was 2,771, a decrease of 38% in acreage compared to the 2015 peak. The decrease was a direct result of improved, strategic off-season and early season mechanical control, and strategic, informed selection of chemical control sites in prior seasons. An unusually wet winter and high winter and spring water flows also contributed to the reduced floating aquatic weed acreage that required treatment in 2017. In 2017, water yellow-primrose was permitted for treatment for the first time for a full field season, and was integrated into the adaptive management framework developed for water hyacinth and spongeplant.

Three additional key indicators of improved floating aquatic weed control observed in 2017 were as follows: First, NASA-Ames reported a 32% decline in 2017 annual peak acreage covered with floating aquatic vegetation, compared to 2015, as detected with Landsat imaging and the NASA Water Hyacinth Mapper Tool that is now being transferred to DBW. Secondly, our collaborators at the UC-Davis Agricultural Issues Center are reporting that costs to stakeholders for local, manual or mechanical aquatic weed control in marinas and water pumping facilities declined by 29%-67% in 2017 compared to past years; DBW's own cost to remove water hyacinth mechanically declined by 82% in 2017. Third and finally, two key recreational boating events in Stockton, CA that had been cancelled due to severe floating aquatic weed infestations for several years prior and up to 2015, were held in 2017, as they were in 2016.

In 2018, DBW will assume the lead role for use of the Water Hyacinth Mapper Tool developed by NASA-Ames. In addition, the first DBW-directed high resolution hyperspectral flights to detect aquatic weeds took place in January 2018. Data from these flights, focused on high-priority areas, will allow further refinement of the adaptive integrated management framework for the aquatic weeds.

For control of submersed aquatic vegetation (Brazilian waterweed and curlyleaf pondweed), the AIS Branch treated a total of 2,273 surface water acres in 2016, an increase of 740 acres over 2015 acreage and 131 acres over 2014 acreage. In 2017, DBW treated 2,967 acres of submersed aquatic weed acreage, exceeding the total for each of the prior four years. For the first time, Eurasian watermilfoil, fanwort, and coontail were added to the list of weeds permitted for treatment during the 2017 treatment season, after completion of required risk analyses and permit amendments. These three weeds are now permitted for treatment using the same chemical and physical strategies and restrictions as for Brazilian waterweed and curlyleaf pondweed, illustrating the robustness and adaptability of the integrated adaptive management framework. As for the floating weeds, stakeholders are reporting that submersed aquatic weed infestations that have plagued various marinas and coves are in decline, as a result of improved strategic management. One example of the improved control techniques implemented by DBW is to apply fluridone pellets every other week instead of every week, leading to improved efficacy with no additional chemical use. DBW has developed and implemented a new Delta-wide 'biovolume'-based underwater survey procedure that precisely quantifies the density of submersed aquatic weeds, to inform selection of treatment sites, and it also evaluates the efficacy of herbicide treatment.

Potential Mechanical Harvesting Sites for 2018 have been identified. This list is very preliminary, and subject to change DBW has identified locations in the Delta for potential mechanical control of water hyacinth, South American spongeplant, and/or Uruguay water primrose for the upcoming year. These sites include Fourteen Mile Slough, or site 28; Empire Tract Slough, or site 15; Trapper Slough, or sites 63 and 64; Stockton area, or site 8; White Slough, or site 36; North Canal/Victoria Channel, or sites 50 and 51; Tracy - Old River, or sites 77, 78, 79, 83a, and 83b; Rock Slough, or site 109; Sycamore Slough, or site 203; Hog Slough, or site 205; Liberty Cut, or sites 270, 271, 275 and 276; Barker Slough or site 284; Eucalyptus Island - Old River, or sites 87a and 87b; and Seven Mile Slough, or site 20, as needed. Additional sites may be identified and considered as the distribution and accumulation of FAV change throughout the year.

Potential Submersed Aquatic Invasive Treatment Sites for 2018 have been identified. This list is very preliminary, and subject to change.Site 8.A, Site 8.D, Site 10.B, 10.W, 14.D, 14.H, 14.P, 15, 18a.K, 18a.P, 18a.W, 20, 22.B, 22.O, 22.S,26, 30, 31, 32, 34, 36, 37, 38, 40.G, 40.T, 62, 79, 87a.I, 87b.I, 87b.k, 88, 91a, 92b, 93, 107, 108,109, 110, 111, 112, 115, 116, 117, 117.F, 117.M, 119b.D, 120b.K, 120b.L, 120b.N, 120b.S, 120b.V,140, 141, 173, 174, 176, 203, 205, 207, 209a, 214, 216, 241, 251a, 252a, 252b, 272.L, 272,284.L, 284.B, 286

Products:

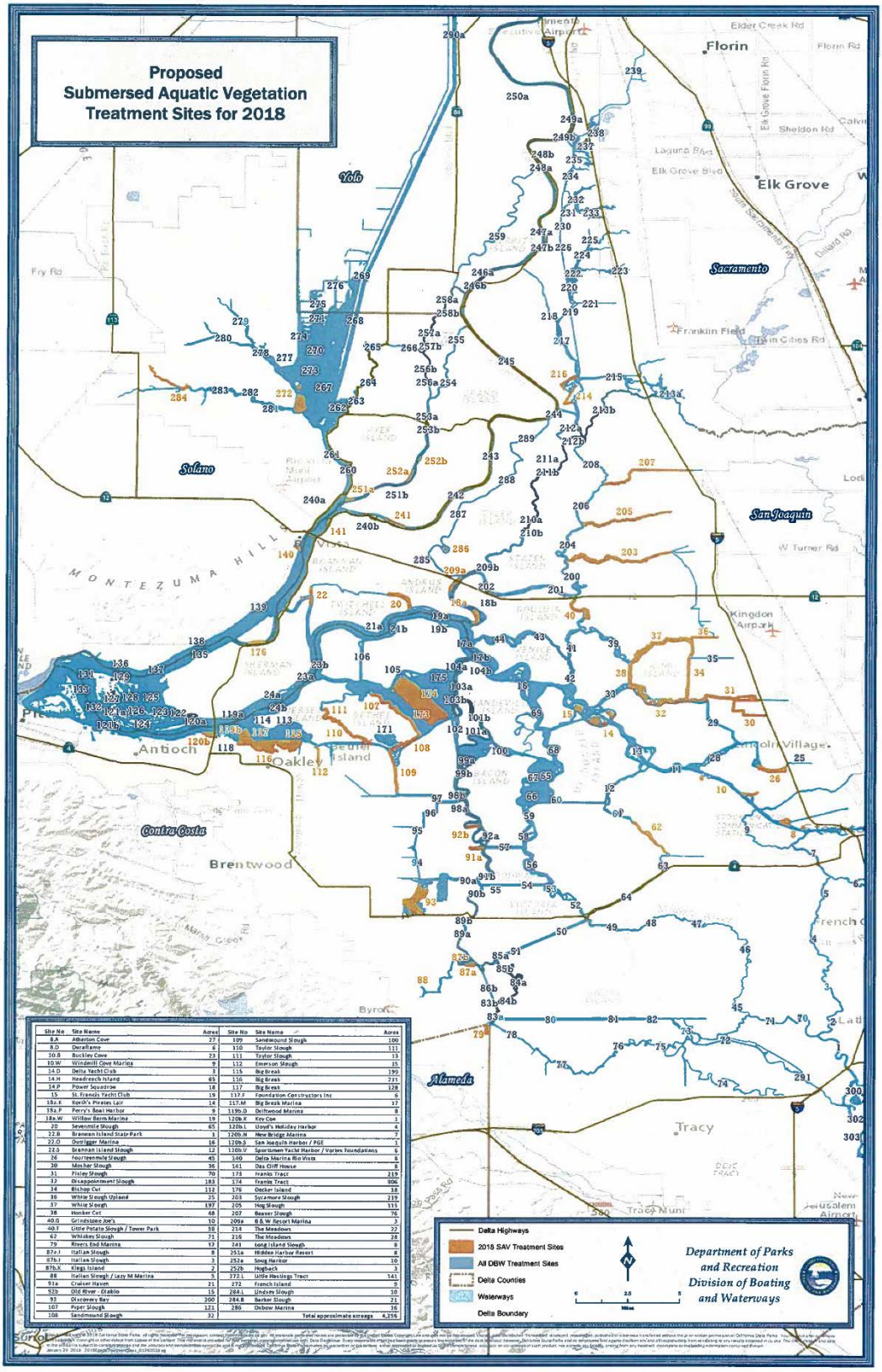
Publications:

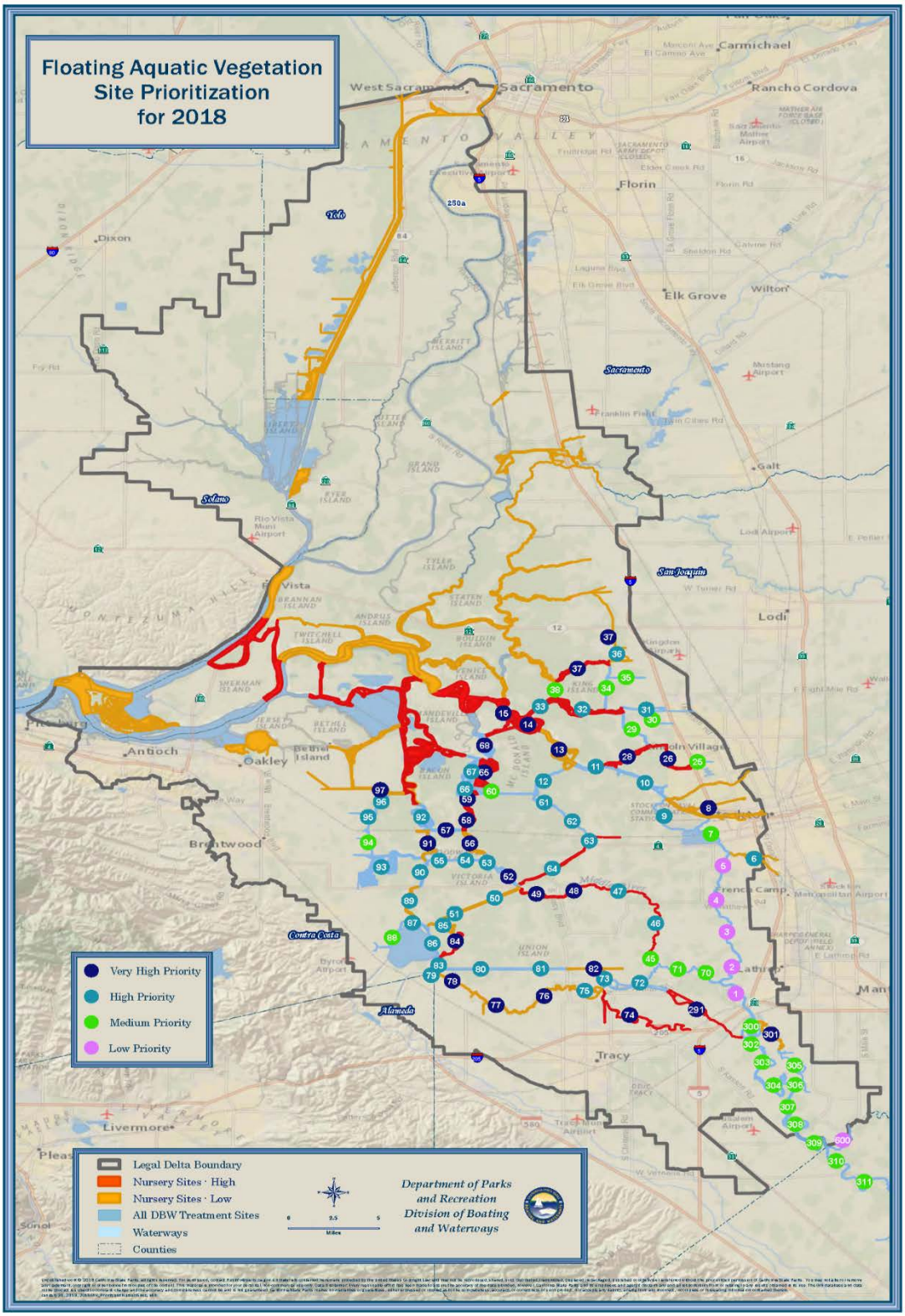
Jin, J. Kurobe T, Ramírez-Duarte, W. F., Bolotaolo, M. B., Lam, C. H., Pandey, P. K., Hung, T.-C., Stillway, M. E., Zweig, L, Caudill, J., Lin, L., Teh, S. 2018. Sub-lethal effects of herbicides penoxsulam, imazamox, fluridone and glyphosate on Delta Smelt (*Hypomesus transpacificus*). Aquatic Toxicology 197: 79-88.

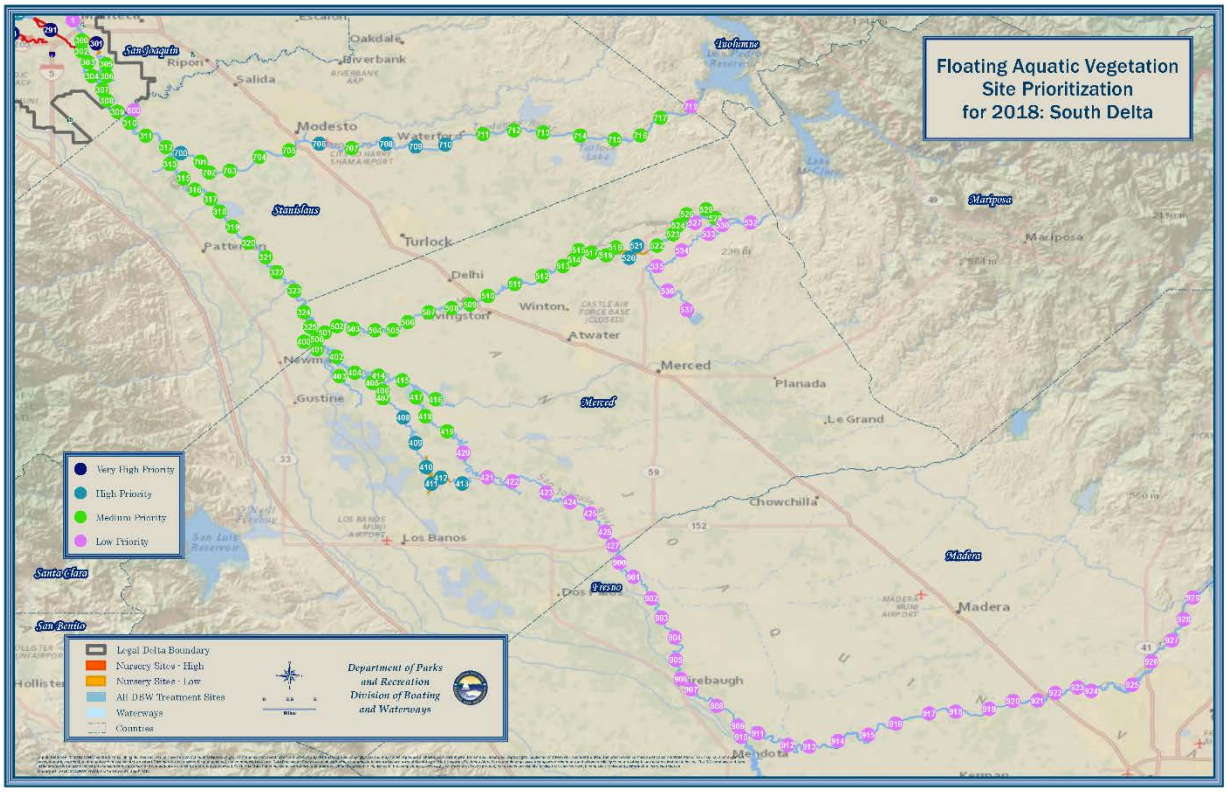
Outreach and Technology Transfer

1. Annual Public Notice of Floating and Submersed Aquatic Weeds Treatment.

2. Weekly email updates on herbicide treatment locations for floating aquatic weeds and (separately) submersed aquatic weeds during treatment season (March 1st-November 30th) distributed to stakeholders who subscribe to email distributions (since March 2015).


Proposed
Submersed Aquatic Vegetation
Treatment Sites for 2018
Florin
Elk Grove
Sacramento
Yolo
Solano
San Joaquin
Contra Costa
Alameda
Antioch
Oakley
Brentwood
Tracy
Byron
Kingdon Airport
Delta Highways
2018 SAV Treatment Sites
All DBW Treatment Sites
Delta Counties
Waterways
Delta Boundary
Department of Parks and Recreation
Division of Boating and Waterways


Floating Aquatic Vegetation
Site Prioritization
for 2018
Very High Priority
High Priority
Medium Priority
Low Priority
Legal Delta Boundary
Nursery Sites - High
Nursery Sites - Low
All DBW Treatment Sites
Waterways
Counties
Department of Parks
and Recreation
Division of Boating
and Waterways
Sacramento
West Sacramento
Carmichael
Rancho Cordova
Florin
Elk Grove
Wilton
Galt
Lodi
Dixon
Vista
Antioch
Oakley
Bethel Island
Brentwood
Tracy
Livermore
French Camp
Contra Costa
Alameda
Solano
San Joaquin
Yolo


Floating Aquatic Vegetation
Site Prioritization
for 2018: South Delta
Very High Priority
High Priority
Medium Priority
Low Priority
Legal Delta Boundary
Nursery Sites - High
Nursery Sites - Low
All DBW Treatment Sites
Waterways
Counties
Department of Parks and Recreation
Division of Boating and Waterways
Oakdale
Riverbank
Salida
Modesto
Waterford
Turlock
Delhi
Winton
Atwater
Merced
Planada
Le Grand
Chowchilla
Madera
Los Banos
Gustine
Newman
Patterson
Escalon
Ripon
Mariposa
Fresno
Tuolumne
Stanislaus
Merced
Madera
Santa Clara
San Benito

SNODGRASS SLOUGH 6/29/2017 R. JAGGI

3

SNODGRASS SLOUGH 7/19/2017 R. JAGGI

5

LOST SLOUGH 06/15/2017 R. JAGGI

6

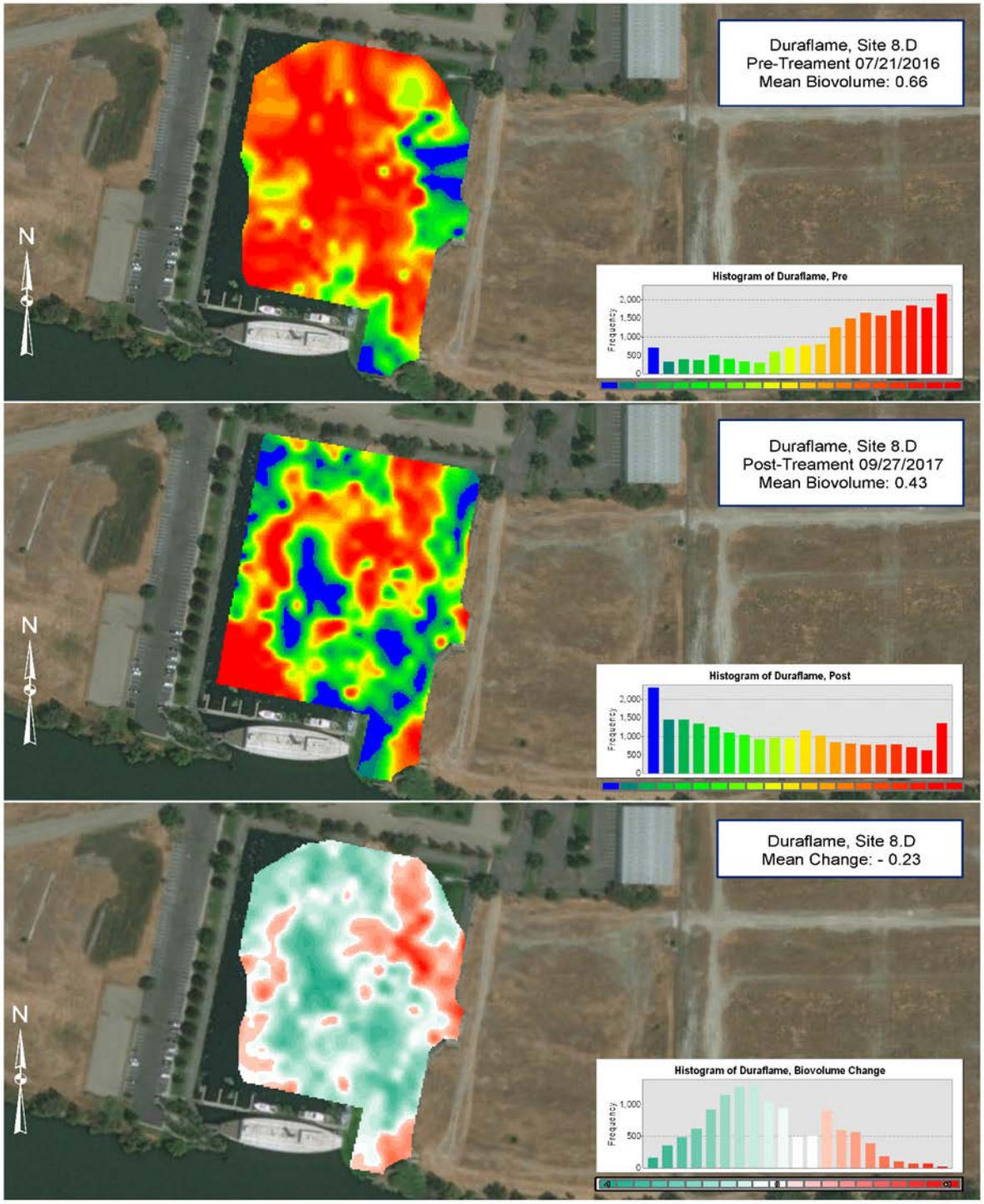
LOST SLOUGH 08/02/2017 R. JAGGI

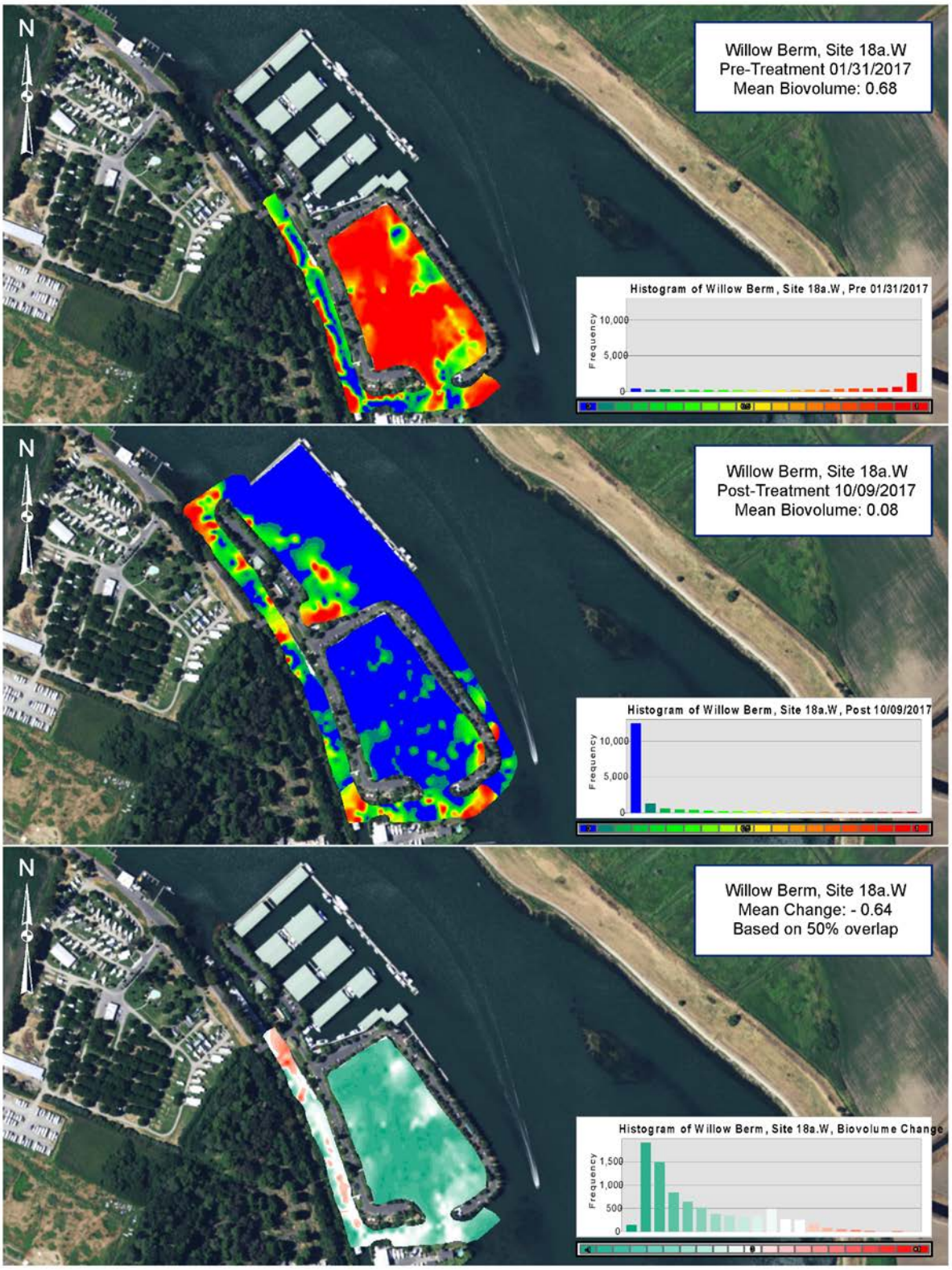
7

LOST SLOUGH 10/30/2017 R. JAGGI

8

Examples of submersed aquatic weed control as detected with a new biovolume survey and analysis tool developed by DBW




N
Willow Berm, Site 18a.W
Pre-Treatment 01/31/2017
Mean Biovolume: 0.68
Histogram of Willow Berm, Site 18a.W, Pre 01/31/2017
Frequency
10,000
5,000
0
N
Willow Berm, Site 18a.W
Post-Treatment 10/09/2017
Mean Biovolume: 0.08
Histogram of Willow Berm, Site 18a.W, Post 10/09/2017
Frequency
10,000
5,000
0
N
Willow Berm, Site 18a.W
Mean Change: - 0.64
Based on 50% overlap
Histogram of Willow Berm, Site 18a.W, Biovolume Change
Frequency
1,500
1,000
500
0

Discovery Bay infestation with submersed aquatic vegetation in October 2014 (left) and September 2016 (right)