Appendix A **Upland transition zone projections**

This appendix was developed by Brian Fulfrost and David Thomson.

Background

Estuarine-Terrestrial Transitional Habitats (hereafter "transitions") are defined by Thomson et al (2013) as:

Estuarine-terrestrial transitional habitats occupy the boundary between land and sea,

from the zone of regular flooding to the effective limit of tidal influence.

They harbor a unique plant community, provide critical wildlife support to adjacent ecosystems,

and play an important role in linking marine and terrestrial processes.

Their character, distribution and extent vary substantially throughout the estuary, controlled primarily by the interaction of topography and the tides. Humans have severely impacted transitions, particularly over the last few centuries, with loss estimates exceeding 90%. A primary driver of this was land "reclamation", which disconnected large tracts of habitats from both estuarine and riverine influences. In most cases the transitional topography still exists, but does not provide the needed ecosystem functions. However they could if reconnected to the estuary and managed for the needed habitats.

As a result, SFBBO in conjunction with Brian Fulfrost & Associates (BFA), developed a GIS based decision support system (DSS) to identify and prioritize tidal marsh-upland ecotonal habitats (transitions) to assist land managers in restoring and protecting San Francisco Bay's (estuary) tidal marsh ecosystem (Fulfrost and Thomson 2015).

The DSS takes a strategic approach towards decision support, by accounting for the landward migration of high marsh and other transitional habitats in response to predicted sea level rise (SLR). Current documents do not adequately describe ecotonal habitats, quantify the amount needed to aid listed species recovery while allowing for SLR, nor prioritize specific sites for protection and restoration. The DSS was developed with regional specialists to describe transitional habitat characters that are important to the tidal marsh ecosystem.

Methods

The transitional zone is largely determined by the extent of the tidal zone, the salinity of the soil, and the consequent distribution of flora. The first component of the transitional zone decision support was to map the potential transitional zone based on tidal and elevation constraints. The resulting landscape-scale transitional topography maps show their current distribution and extent. The few still connected to the estuary are termed "existing transitions"; those disconnected by water control structures (such as levees) are termed "potential transitions". These transitions, when viewed with the distribution and extent of tidal marshes can help managers visualize where they are lacking (i.e. requiring creation) and where they are plentiful (i.e. requiring protection). Transition zones were also mapped according to two Seas Level Rise time horizons (“high” 2050 = 61cm; “high 2100 = 167cm) identified by the National Research Council (NRC 2013), in order to predict likely changes in distribution and extent through time.

Results and Discussion

Although the movement of transitions away from the estuary was predicted, Fulfrost and Thomson's research found that the extent (i.e. acreage) of transitions will diminish over time because the tidal elevation required for transitions zone decrease as slopes generally increase with distance from the estuary (see table and graphs below). Simply put there will be less acreage of upland transitional habitat in the future surrounding the estuary.

Existing transitions (i.e. connected to the estuary) are projected to be eliminated by SLR around 2100, so they must either be created through filling the estuary or levees moved to reconnect potential transitions to the estuary. Creating transitions requires filling the estuary, converting lower elevation habitats into higher ones in preparation for future sea levels. Identifying which is more feasible, massive earthwork projects or moving levees and purchasing large tracts of land, will require landscape scale planning projects. Our DSS would provide useful information to such a project, but is primarily designed to help managers identify where their resources will provide the greatest impact.

Fulfrost and Thomson have begun enhancing their DSS by creating an indexed set of metrics that utilize commonly available regional datasets to characterize the transitions, already identified by tidal elevations, by their quality for tidal marsh ecosystem management. These data allow the DSS to improve the identification of sites by management where restoration or enhancement actions are of greatest value. The final output of the DSS is a GIS that identifies transitional topography and ranks them according to their value to tidal marsh ecosystem management.

Although beyond the scope of Fulfrost and Thomson's project, it is likely the most usable topography for estuarine-terrestrial transitions will be up the river valleys. Currently these areas are wetlands of varying salinities or riverine-upland transitions (aka riparian habitat), but SLR will cause the estuary to colonize them, raising salinities and changing habitat types. If the future extent of salinity zones could be modeled then a project such as ours could be utilized to predict the future distribution and extent of tidal salt and brackish marsh-terrestrial transitional habitats up these valleys, which could be prioritized for conservation of the future tidal marsh ecosystem.

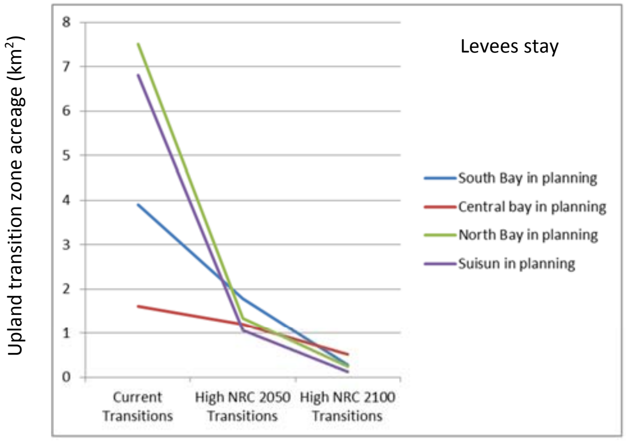
References

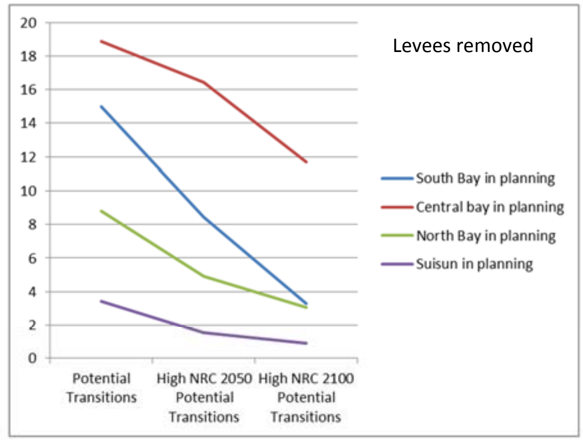
Thomson, D., et al. Critical Tidal Marsh Ecosystem Habitats at the Bay's Margin : A description. December 2013. Report of pilot project produced for USFWS Coastal Program.

Fulfrost, B., and Thomson, D. San Francisco Bay Margin Conservation and Management Decision Support System (DSS). April 2015. Report of pilot project produced for USFWS Coastal Program.

		Current and Projected Upland Transition Zone Habitat (km^2)					
Subregion		**Current**		**High NRC SLR 2050 (61 cm)**		**High NRC SLR 2100 (167 cm)**	
		tidal	non-tidal	tidal	non-tidal	tidal	non-tidal
North Bay	inside	7.50	8.79	1.33	4.90	0.25	3.06
	outside	-	2.86	0.00	2.21	0.00	4.32
Suisun	inside	6.80	3.42	1.07	1.53	0.12	0.88
	outside	-	0.69	0.00	0.57	0.00	1.01
Central Bay	inside	1.61	18.86	1.20	16.42	0.52	11.68
	outside	-	1.03	0.00	2.16	0.00	4.34
South Bay	inside	3.90	14.97	1.78	8.45	0.28	3.27
	outside	-	20.75	0.00	17.37	0.00	19.06

NRC = National Regulatory Commission; SLR = sea-level rise; inside = within planning area of SF Bay Estuary; outside = beyond planning area of the Estuary.





No upland transition zone beyond planning boundary of Estuary if levees stay

Note that vertical axes differ among graphs.