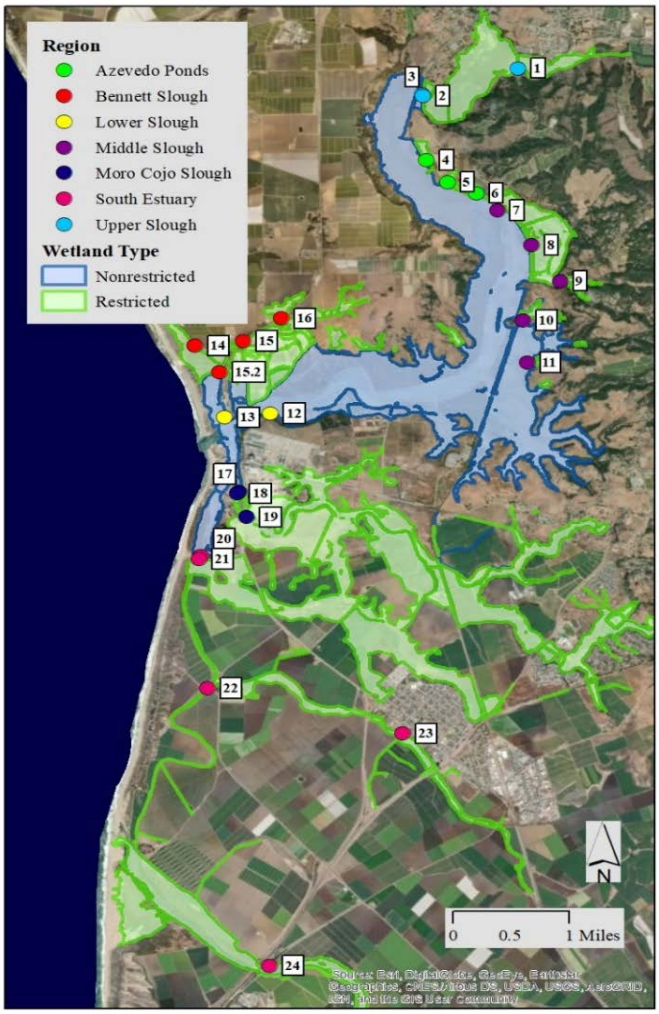
Elkhorn Slough Estuary: 30 Years of Water Quality Trends



Three decades ago, Elkhorn Slough Reserve, the Elkhorn Slough Foundation, and Monterey County began a monthly water quality monitoring program in the estuary. Studying water quality trends over long periods of time allows us to characterize spatial patterns (like in the Water Quality Report Card) and trends over time. When we study long term water quality trends, we can identify management actions to make the estuary healthier for wildlife, habitats, and humans.

The map to the left shows the 25 sites that have been part of our three-decade study, with each region indicated in a different color.

ID	Site Name	ID	Site Name
1	Carneros Creek	13	Skipper's Landing
2	Blohm Porter Marsh	14	Bennett Slough, West
3	Hudson Landing	15	Bennett Slough, East
4	Azevedo Pond, North	15.2	Jetty Road
5	Azevedo Pond, Central	16	Struve Pond
6	Azevedo Pond, South	17	Moss Landing Road, North
7	Kirby Park	18	Moss Landing Road, South
8	Reserve North Marsh	19	Moro Cojo Slough
9	Strawberry Road	20	Potrero Road, North
10	Whistlestop Lagoon	21	Potrero Road, South
11	South Marsh	22	Monterey Dunes Way
12	Vierra	23	Tembladero Slough
		24	Salinas River Bridge

Three key nutrients can be measured to investigate the health of estuaries: ammonia, nitrate, and phosphate. High concentrations of nutrients in estuaries can throw the ecosystem off-balance.

Just like fertilizing a garden, nutrients can make algae bloom in the estuary. Large blooms can be problematic. Once the excess algae die, microbes decomposing the algae can use up all the dissolved oxygen in the water, such that other organisms like fish or oysters can't respire (or breathe) and may die.

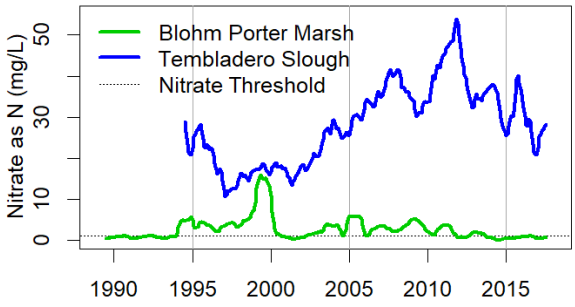
To monitor nutrients, long-term data have been collected at the estuary dating back to 1989. Elkhorn Slough has a number of different regions, each with some sites that are open to regular tidal flushing and some that have restricted flow. Historically, the sites with tidal restriction have been found to have poorer water quality.

Nutrient Data Trends

At 25 sites in the watershed we analyzed approximately 30 years of data on ammonia, nitrate, and phosphate. Although each of the 25 sites has its own unique water quality, the graph below of nitrate at Blohm Porter Marsh (green) and Tembladero Slough (blue) demonstrates the type of results produced by the study. At Blohm Porter Marsh, nitrate levels began low, increased for a period, then decreased. At Tembladero Slough, nitrate began high (many times the threshold) and increased over time.

Discussion of the Trends

We found some encouraging improvements as a result of studying the long-term water quality trends. Throughout all the sites, about 50% of all water quality parameters have showed improvement. 20% have worsened and 30% have had no change during the last 30 years (see chart below). The regions that had the most improved parameters were the Upper Slough, Azevedo Pond Sites, the Middle Slough, and Bennett Slough.



Local management practices appear to influence water quality trends. Even within regions, sites can differ from the regional pattern. This suggests that local factors may have as big of an impact as larger-scale weather trends. More research on other factors, such as the role of different agricultural and wetland management practices, is needed to help understand how water quality can further be improved. This will allow resources to be appropriately directed.

In the chart below, green arrows pointing downward mean that concentrations of that nutrient have decreased over the 30 years of the study. Red, upward-facing arrows mean deterioration of water quality. The "ns" indicates that no significant change occurred in water quality over the 30 years. Sites with an "r" are sites with restricted flow. The final column to the right is the average Water Quality Report Card grade for the last 5 years.

Key actions to improve water quality:

By citizens:

- Support local farmers implementing sustainable practices
- Vote for measures and representatives that support healthy water quality
- Volunteer for coastal clean-ups or to help water quality monitoring

By organizations:

- Improve management of water control structures to allow for more natural tidal circulation which can flush out nutrients
- Restore lost salt marshes, which can help improve water quality
- Conduct further research to understand exactly which land management practices support healthiest water quality
- Support farmers in implementing measures that reduce polluted run-off

		Ammonia	Nitrate	Phosphate	Grade
Upper Slough	1r	↑	↓	ns	F
	2r	ns	ns	↓	F
	3	ns	↓	↓	D
Azevedo	4r	↓	↓	↓	D
	5r	↓	↓	↓	F
	6r	↓	↓	ns	F
Middle Slough	7	↓	↓	↓	C
	8r	↑	↑	ns	C
	9r	ns	↓	ns	F
	10	↓	↓	↓	C
	11	↓	↓	↓	C
Bennett Slough	16r	↓	↓	↓	F
	15r	↓	↓	↓	D
	14r	ns	ns	ns	
	15.2r	↑	ns	↓	C
Lower Slough	12	↑	↑	↓	C
	13	↑	ns	↓	C
Moro Cojo Slough	19r	ns	ns	↑	F
	18r	↑	ns	↑	F
	17	ns	↑	ns	D
South Estuary	24r	ns	ns	↑	F
	23r	↓	↑	↓	F
	22r	↓	ns	ns	F
	21r	↓	↑	ns	F
	20	ns	↑	↑	F

Join our effort!

The Elkhorn Slough National Estuarine Research Reserve – a combined effort of the California Department of Fish and Wildlife, the National Oceanic Atmospheric Administration, and the Elkhorn Slough Foundation – is dedicated to conducting research to better understand water quality and estuarine ecology, implement salt marsh restoration projects, and increase public awareness about the importance of estuaries.

Learn about opportunities to volunteer your time at the Reserve or support efforts by both the Reserve and Foundation to improve water quality in the estuary at: www.elkhornslough.org

This document was prepared by the Elkhorn Slough National Estuarine Research Reserve. You can find a full length report at:
http://www.elkhornslough.org/research-program/technical-report-series/

Email John Haskins, john@elkhornslough.org, with questions or comments.