Kettle ponds

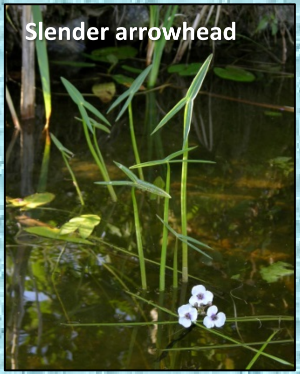
Permanently-flooded depressions created by the weight of glacial ice-blocks

Environment

- glacial outwash plain throughout Cape
- range in trophic state, but many are oligotrophic (low nutrient concentrations)

Kettle pond complex (Wellfleet and Truro)

CCNS Kettle Ponds: Resource Values



Native plants (including rare)

Wildlife (including rare)

Recreational opportunities (some have negative impacts)

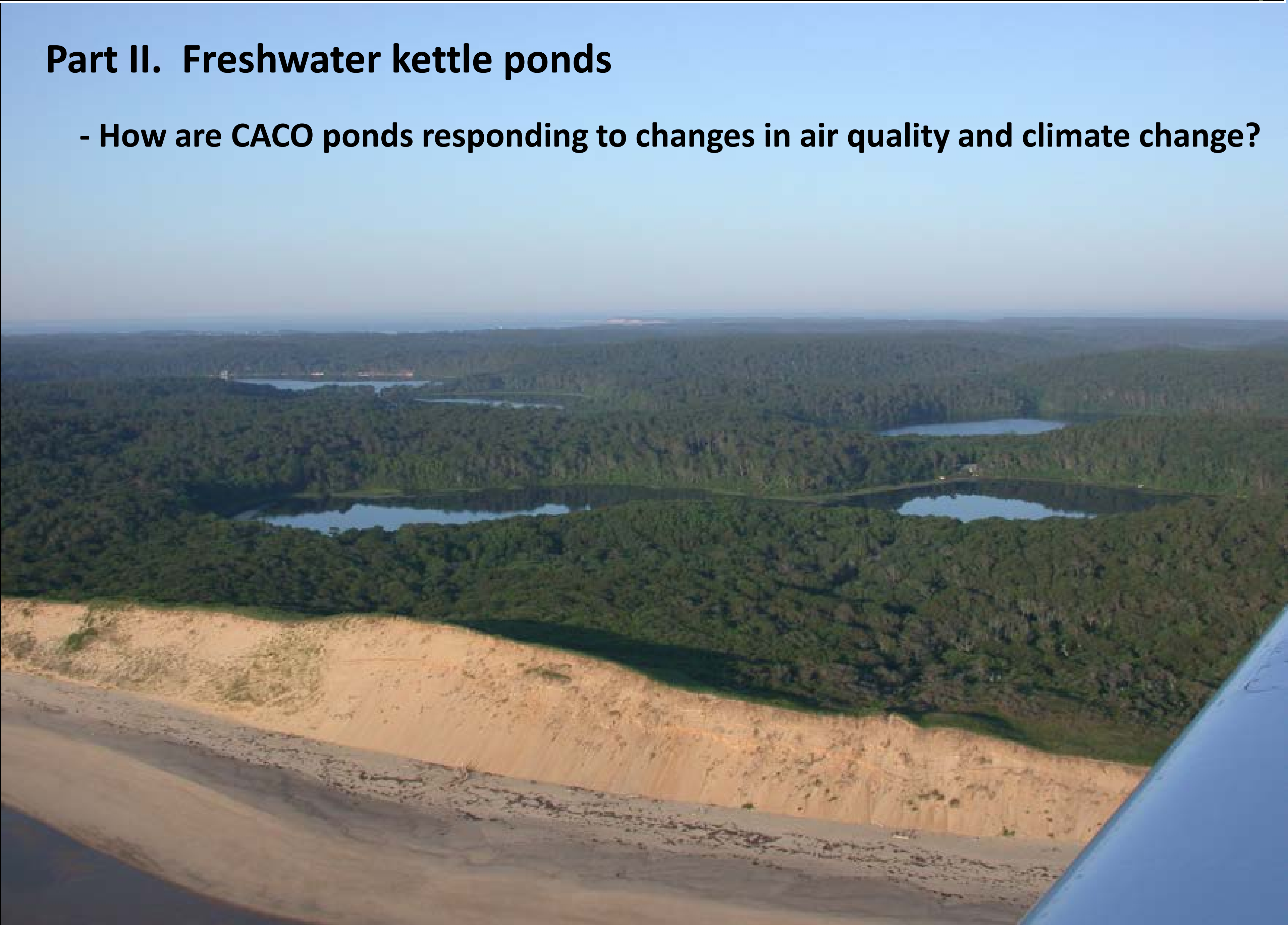
Scenery

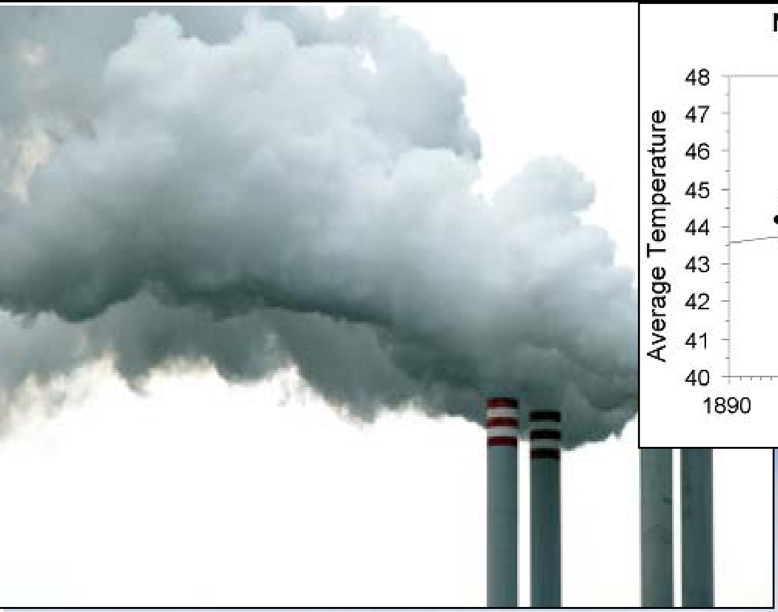
Clean drinking water

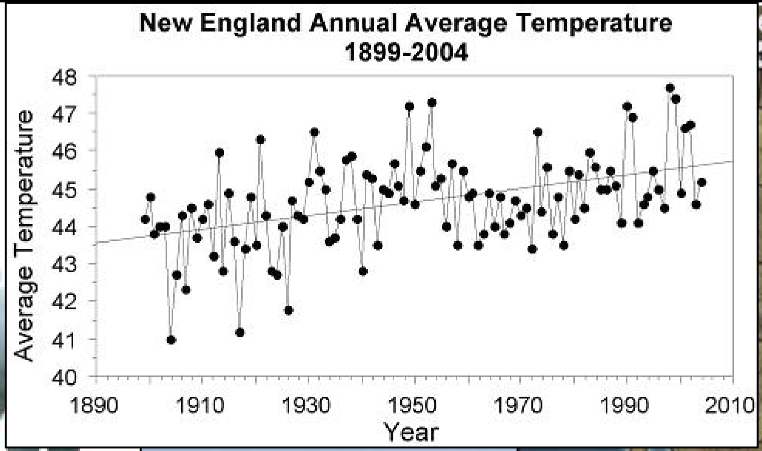
Shoreline rehab

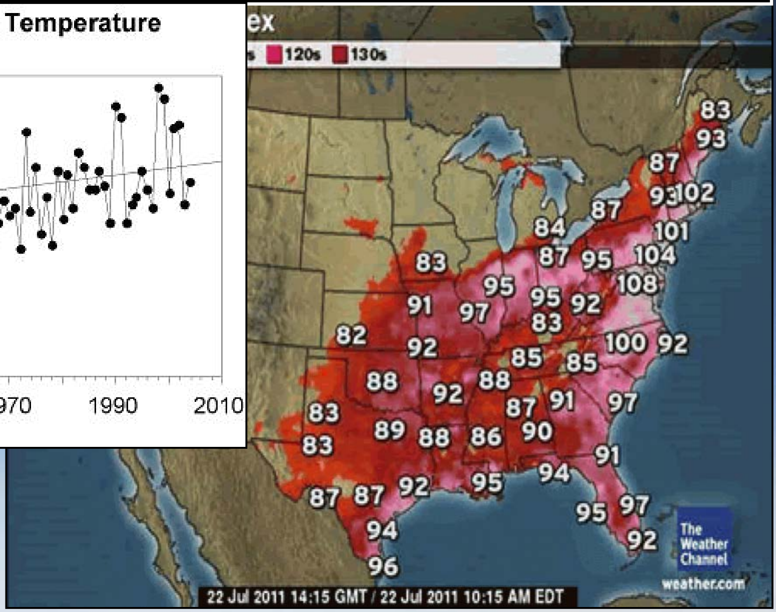
Part II. Freshwater kettle ponds

- How are CACO ponds responding to changes in air quality and climate change?









- **The acidity of precipitation (measured as pH) has generally declined**, mostly due to reductions in sulfur dioxide (SO_2) and to a lesser extent nitrous oxides (NO_3 and NO_2) emissions

- **The climate has warmed**. Air temperatures around New England and in the larger northeast region of the U.S. have risen by 1-4°C over the last century

CACO kettle ponds are 'isolated' in that they have no inflow/outflow and are therefore *closely tied to the quality/quantity of rainfall and atmospheric conditions*

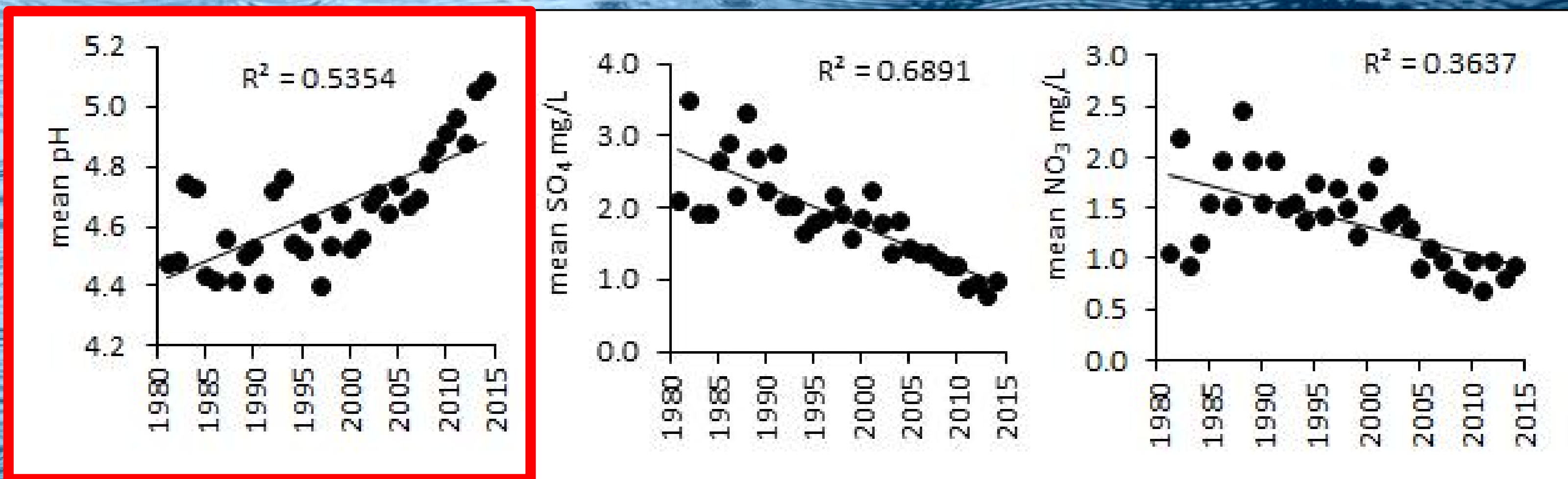
How have our kettle ponds responded to changes in these conditions?

- **CACO kettle pond WQ monitoring program**
- **CACO air quality monitoring program**

Methods

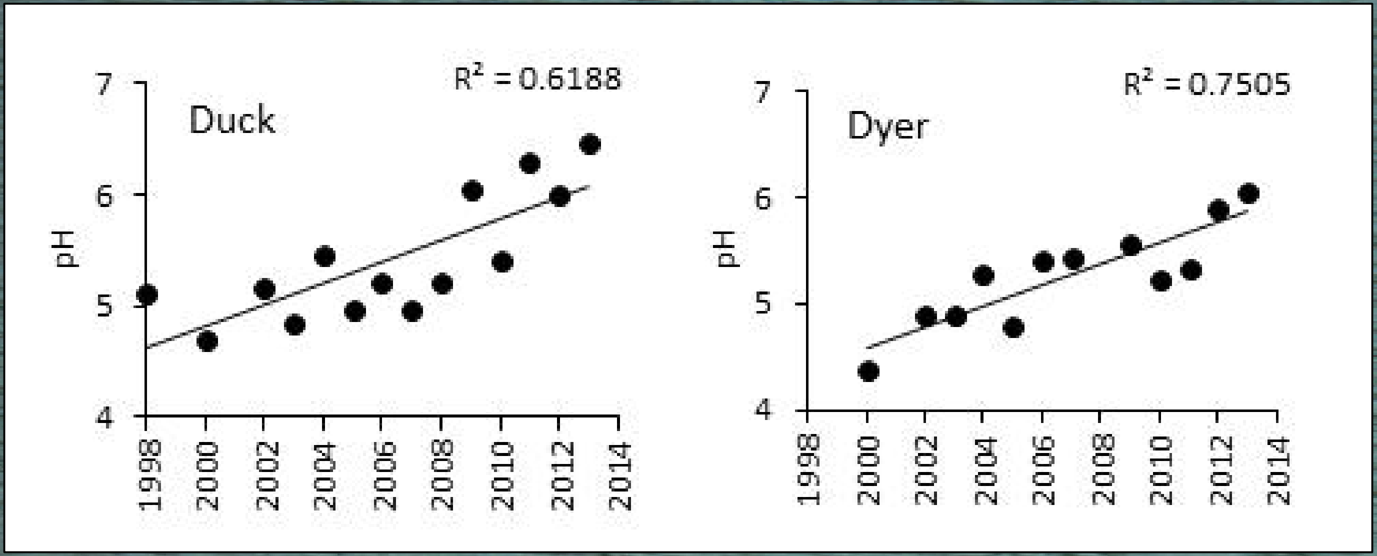
- Air temperature data were available from the Chatham airport (Chatham WSMO station, Northeast Climate Center database) approximately 32 km away from the cluster of CCNS kettle ponds (Figure 1
- Precipitation chemistry has been determined from samples collected weekly since 1981 at MA01. This analysis focused on precipitation pH, and two important contributors to pH - nitrate (NO_3) and sulfate (SO_4) concentrations (mg/L).
- Pond pH and surface water temperature were measured at a water depth of 0.5 m using Hydrolab™ water quality sondes until 2002 and with YSI™ sondes thereafter.

Rainwater pH, SO_4, NO_3 at MA01 (Truro)



A pH increase of 1 unit = 10x less acidic

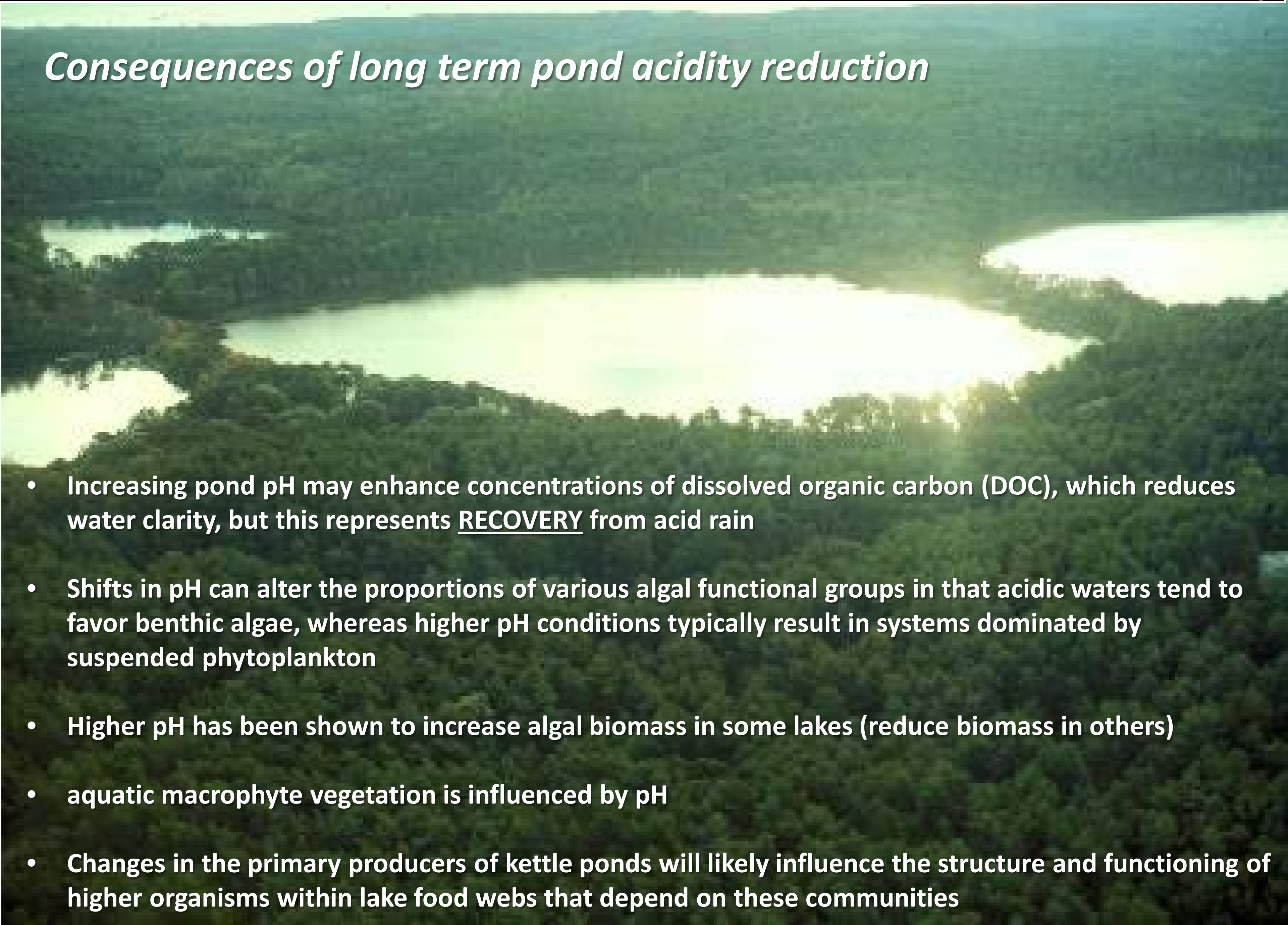
Surface water acidity (pH) of ponds



Surface water pH increasing (decreasing acidity)

Pond	R^2	p	n	change	% change	Time series	Obs/yr
All ponds	0.59	0.01	10	0.9	17%	2000, 2003-2004, 2006-2007, 2009-2013	10 (1/pond)
Duck	0.62	<0.01	14	1.5	32%	1998, 2000, 2002-2013	2
Dyer	0.75	<0.01	12	1.3	28%	2000, 2003-2007, 2009-2013	2
Great-T	0.21	0.16	11	0.3	6%	2003-2013	2
Great-W	0.35	0.03	14	0.9	20%	1996-1998, 2000-2013	1
Gull	0.18	0.15	13	0.4	6%	2000-2013	2
Herring	0.23	0.06	16	0.7	11%	1996-1998, 200-2001, 2003-2013	1
Long	0.20	0.11	14	0.4	9%	1998, 2000, 2002-2013	2
Ryder	0.45	<0.01	16	2.0	44%	1997-1998, 2000-2013	1
Snow	0.02	0.71	11	0.1	1%	2002, 2004-2013	2
Spectacle	0.03	0.55	15	0.2	4%	1997-1998, 2000-2001, 2003-2013	1

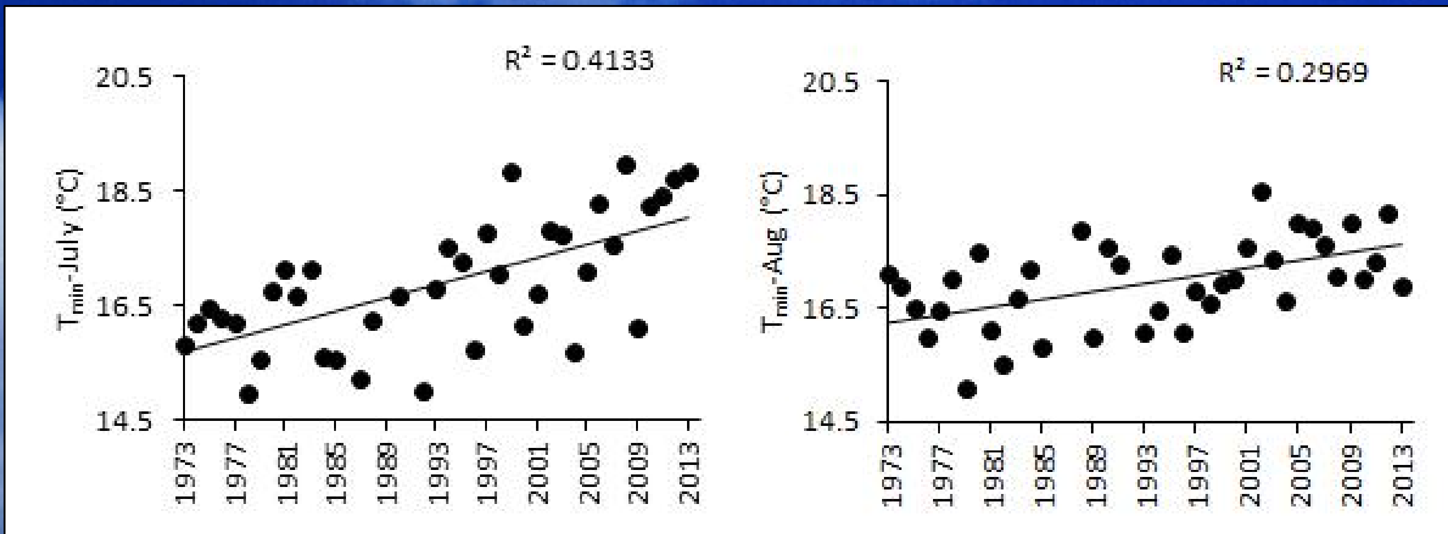
* A change of 1 pH unit = 10 fold change in acidity



Consequences of long term pond acidity reduction

- Increasing pond pH may enhance concentrations of dissolved organic carbon (DOC), which reduces water clarity, but this represents RECOVERY from acid rain
- Shifts in pH can alter the proportions of various algal functional groups in that acidic waters tend to favor benthic algae, whereas higher pH conditions typically result in systems dominated by suspended phytoplankton
- Higher pH has been shown to increase algal biomass in some lakes (reduce biomass in others)
- aquatic macrophyte vegetation is influenced by pH
- Changes in the primary producers of kettle ponds will likely influence the structure and functioning of higher organisms within lake food webs that depend on these communities

Air temperature – mean daily maximum and minimum temperatures

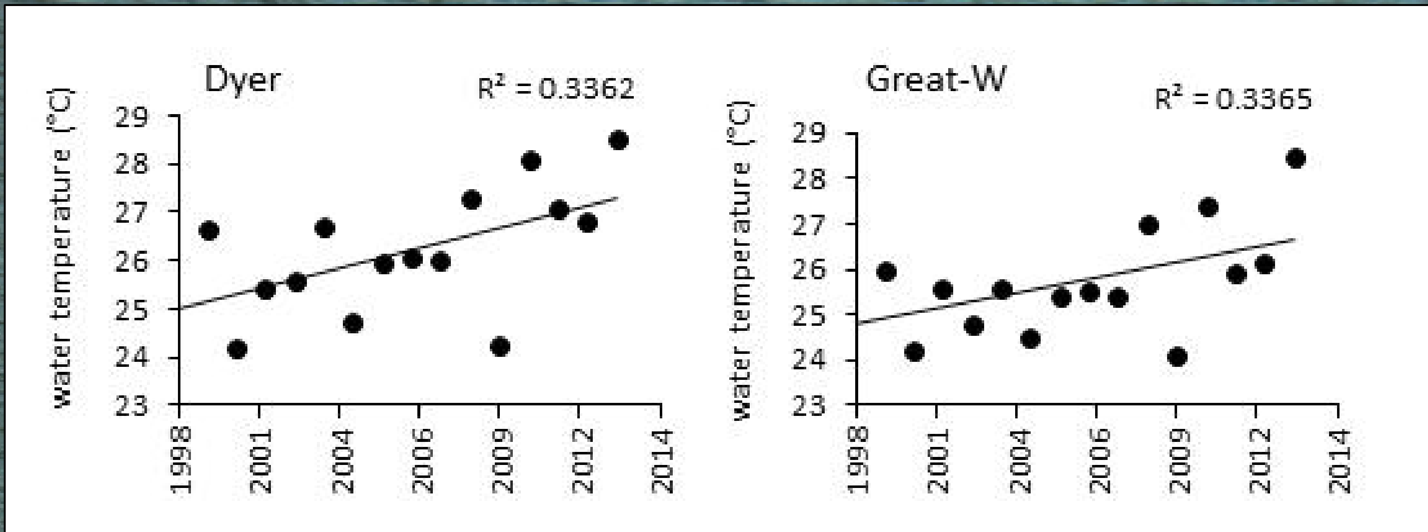


	T_{max}				T_{min}			
Month	R^2	**p**	**Trend**	**change**	R^2	**p**	**Trend**	**change**
April	0.001	0.84	+	0.06	0.09	0.06	+	0.83
May	0.120	0.03	+	0.16	<0.01	0.79	+	0.96
June	0.042	0.21	+	0.65	0.30	<0.01	+	1.60
July	0.080	0.09	+	0.87	0.41	<0.01	+	2.16
August	0.077	0.09	+	0.51	0.30	<0.01	+	1.22
September	0.152	0.01	+	1.15	0.42	<0.01	+	2.25
October	0.089	0.06	+	1.19	0.17	0.01	+	1.76
November	0.018	0.42	+	0.52	0.02	0.36	+	0.69

Air temperatures, particularly minimums, in the summer/fall months are increasing

*** highlighted rows indicate that change is statistically significant**

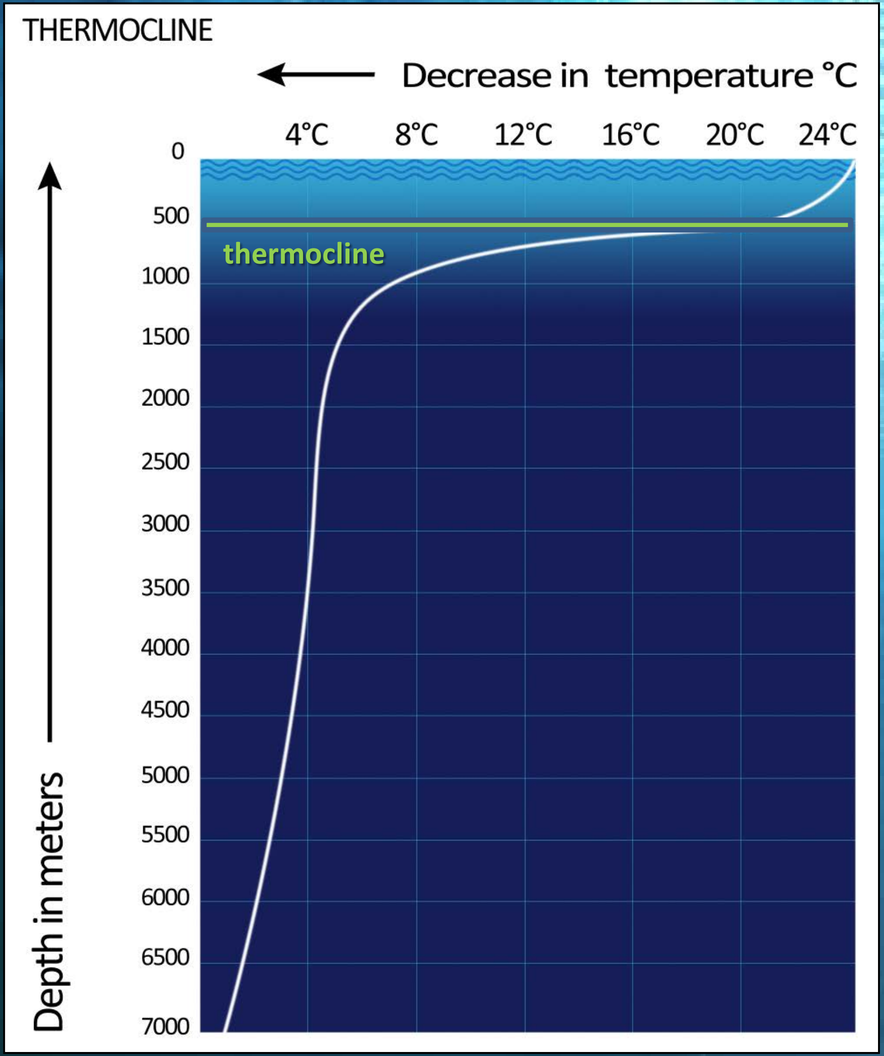
Surface water temperature of ponds



Surface water temps increasing

July	R^2	p	n	change (°C)	% change	Time series
All ponds	0.23	0.04	18	1.9	8%	1996-2013
Duck	0.29	0.00	26	2.6	11%	1988-2013
Dyer	0.34	0.02	16	2.3	9%	1998-2013
Great-T	0.10	0.12	25	1.3	5%	1988-2013
Great-W	0.34	0.01	18	2.3	10%	1996-2013
Gull	0.26	0.01	25	2.0	8%	1988-2013
Herring (Aug)	0.30	0.02	17	1.6	7%	1996-2013
Long	0.32	0.01	18	2.4	10%	1996-2013
Ryder	0.22	0.03	21	1.8	7%	1992, 1994-2013
Snow	0.22	0.05	18	1.9	8%	1996-2013
Spectacle	0.09	0.19	22	1.3	5%	1998-2000, 2002-2013

Changing vertical temperature structure



Depth, duration, and strength of thermocline affects:

- **vertical mixing**
- **nutrient availability**
- **light attenuation**

↓

- **phytoplankton species composition, biomass**

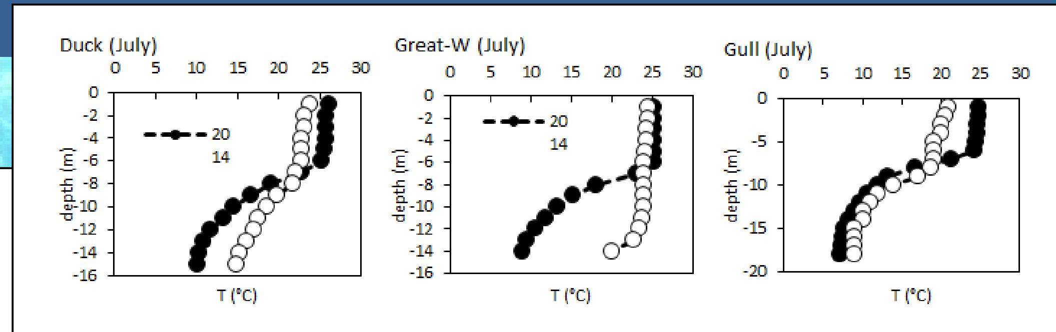
↓

- **zooplankton**

↓

- **fish and higher organisms**

Depth of thermocline – depth at which there is the largest temperature drop over a span of 1 m vertical depth



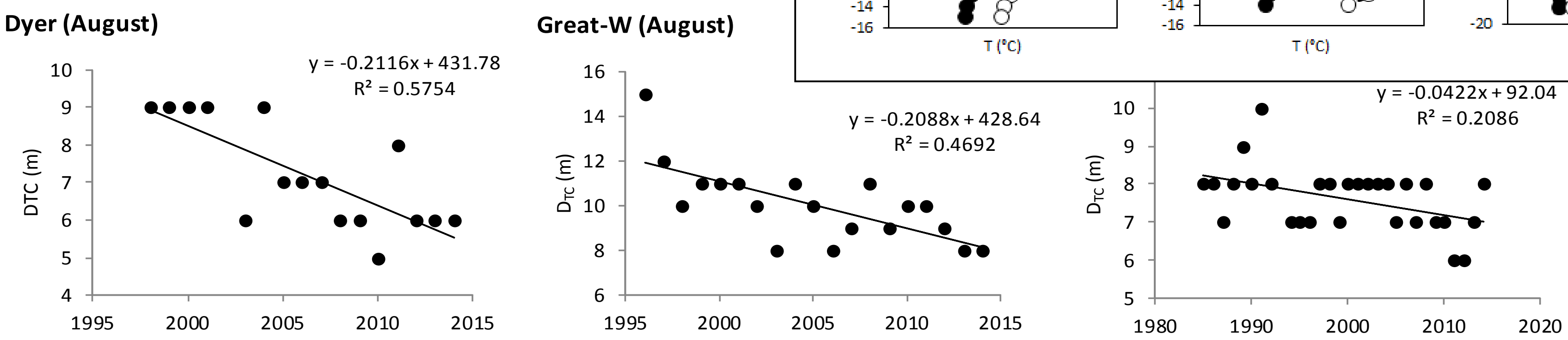


Figure 2. D_{TC} plotted against time for Dyer and Great-W ponds in August and Gull pond in July.

Shallower depth of thermocline in most ponds

	KT	p	July change	% change	KT	p	August change	% change
Duck	-0.42	0.005	-2.1	-25%	-0.26	0.12	-1.1	-14%
Dyer	-	-	-	-	-0.61	0.00	-3.2	-36%
Great-T	-0.21	0.162	-0.9	-17%	-0.20	0.19	-0.8	-14%
Great-W	-0.51	0.004	-3.7	-32%	-0.56	0.00	-3.5	-30%
Gull	-0.34	0.023	-1.2	-14%	-0.16	0.30	-0.4	-5%
Herring	0.11	0.629	0.2	4%	0.24	0.21	0.6	20%
Long	-0.02	0.912	-0.2	-3%	-0.11	0.56	-0.6	-7%
Round-W	-	-	-	-	-0.50	0.01	-1.7	-27%
Ryder	-0.28	0.077	-1.7	-24%	-0.33	0.07	-0.9	-12%
Slough	-	-	-	-	0.48	0.02	3.3	89%

Change in temperature at upper and lower boundary of thermocline (1m vertical span)

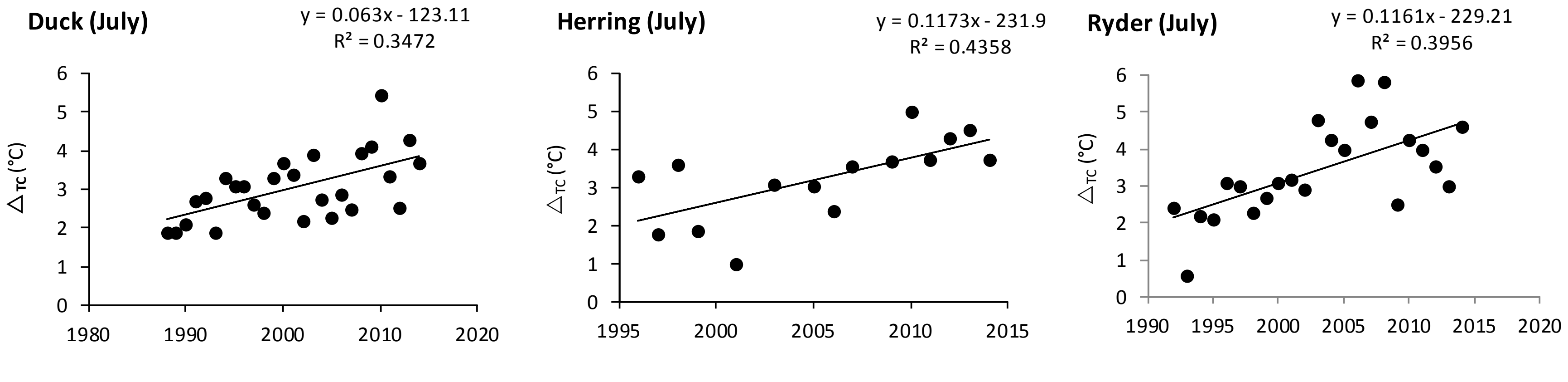


Figure 3. $\triangle_{TC}$ plotted against time for Duck, Herring and Ryder ponds in July.

Stronger thermocline

3 m —— warm layer

4 m —— cold layer

	R^2	p	July change	% change	R^2	p	August change	% change
Duck	0.35	0.00	1.6	71%	0.31	0.00	1.3	48%
Dyer	-	-	-	-	0.40	0.01	3.0	237%
Great-T	0.01	0.58	0.4	8%	0.12	0.07	0.8	23%
Great-W	0.20	0.05	1.2	52%	0.19	0.06	1.1	42%
Gull	0.05	0.26	0.6	17%	0.01	0.62	0.3	7%
Herring	0.44	0.01	2.0	93%	0.33	0.01	2.3	255%
Long	0.02	0.61	-0.3	-9%	0.14	0.12	1.2	39%
Round-W	-	-	-	-	0.51	0.00	1.9	44%
Ryder	0.40	0.00	2.4	113%	0.11	0.15	1.0	29%
Slough	-	-	-	-	0.31	0.02	1.6	922%

* Difference between surface and bottom water temperatures

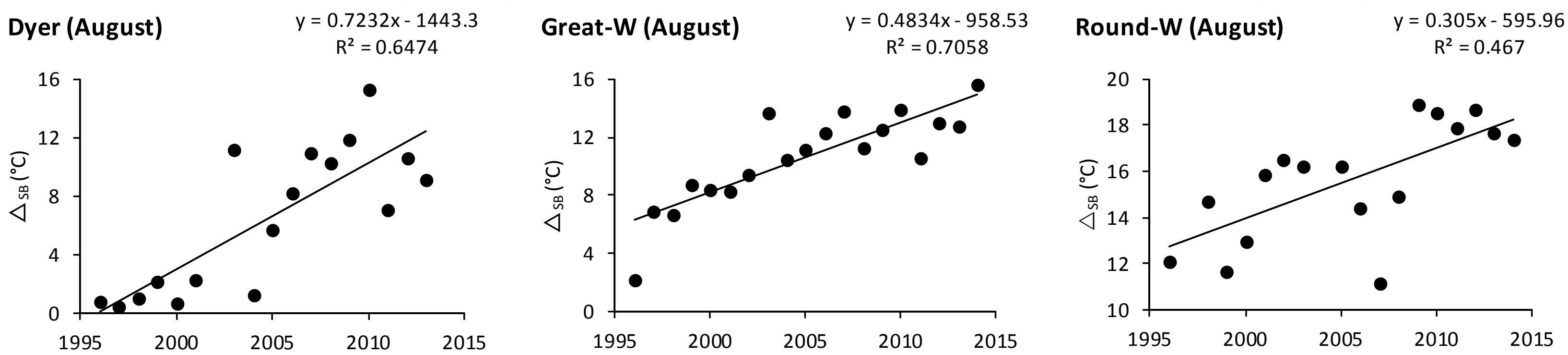


Figure 4. $\triangle_{SB}$ plotted against time for Dyer, Great-W, and Round-W ponds in August.

Stronger total (i.e., whole pond) vertical temperature differences

	years	R^2	p	July change	% change	R^2	p	August change	% change
Duck	1988-2014	0.46	0.00	5.8	50%	0.46	0.00	4.2	34%
Dyer	1997-2014	0.57	0.00	10.3	482%	0.65	<.0001	11.6	6503%
Great-T	1984-2014	0.11	0.08	1.9	12%	0.06	1.53	1.2	8%
Great-W	1996-2014	0.70	<.0001	5.7	64%	0.71	<.0001	8.2	131%
Gull	1985-2014	0.10	0.00	5.8	50%	0.46	0.00	4.2	34%
Herring	1996-2014	0.34	0.00	4.8	268%	0.41	0.00	4.0	322%
Long	1996-2014	0.15	0.12	2.8	24%	0.10	0.20	2.1	18%
Round-W	1996-2014	0.47	0.00	5.2	41%	0.47	0.00	5.2	41%
Ryder	1992-2014	0.39	0.00	5.0	46%	0.27	0.02	3.5	30%
Slough	1996-2014	-	-	-	-	0.50	0.01	2.8	406%

Bottom water temperatures

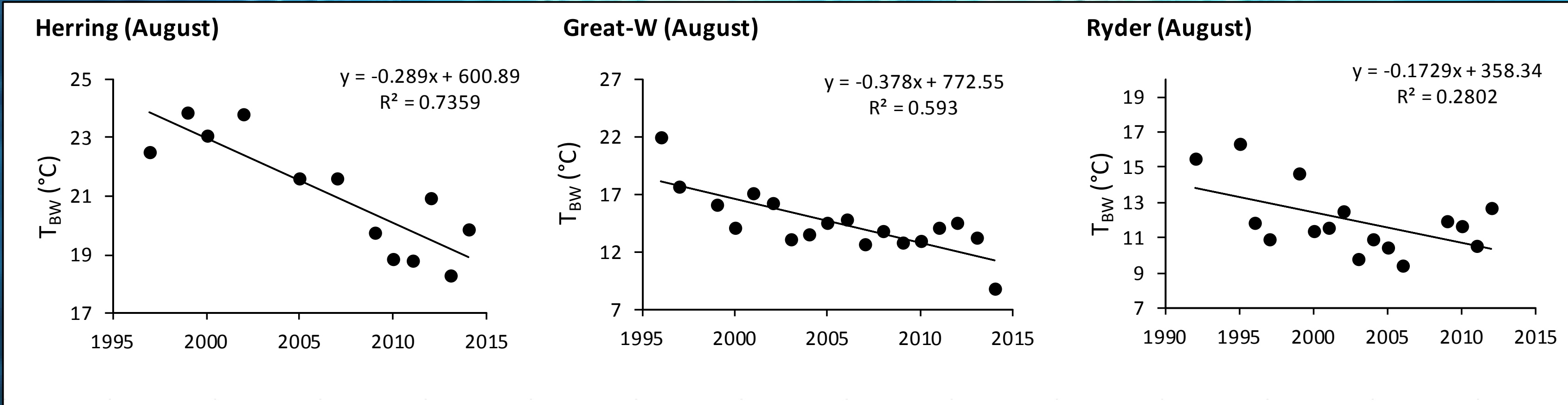


Figure 5. T_{BW} plotted against time for Herring, Great-W, and Ryder ponds in August.

decrease in bottom water temperatures

Overall, ponds more thermally stable in summer

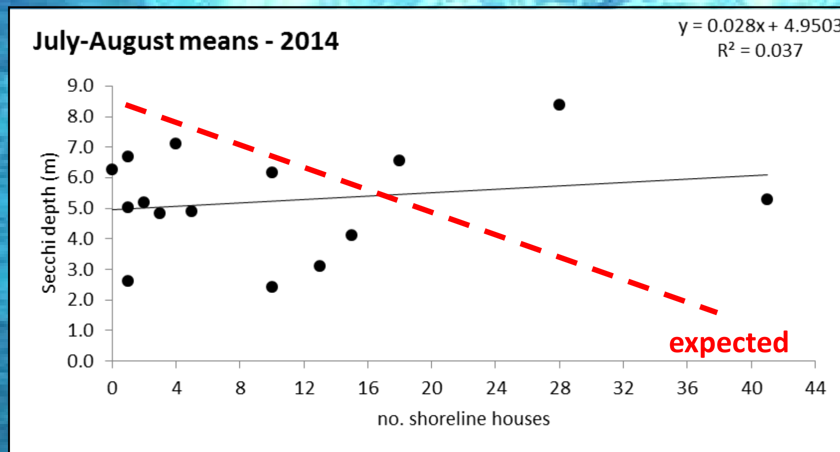
	R^2	p	July change	% change	R^2	p	Aug change	% change
Duck	0.20	0.05	-2.12	-19%	0.11	0.274	-1.62	-14%
Dyer	0.73	0.00	-9.86	-43%	0.64	0.001	-8.98	-40%
Great-T	0.01	0.73	-0.34	-19%	0.02	0.623	-0.48	-5%
Great-W	0.63	<.0001	-6.45	-36%	0.59	0.0002	-6.80	-38%
Gull	0.11	0.29	-0.62	-8%	ND	ND	ND	ND
Herring	0.74	0.00	-3.65	-16%	ND	ND	ND	ND
Long	0.06	0.38	-1.42	-11%	0.02	0.612	-0.24	-2%
Round-W	-	-	-	-	0.40	0.049	-3.52	-31%
Ryder	0.12	0.16	-3.55	-26%	0.28	0.035	-2.59	-19%
Slough	ND	ND	-1.83	-7%	0.13	0.204	-1.83	-7%

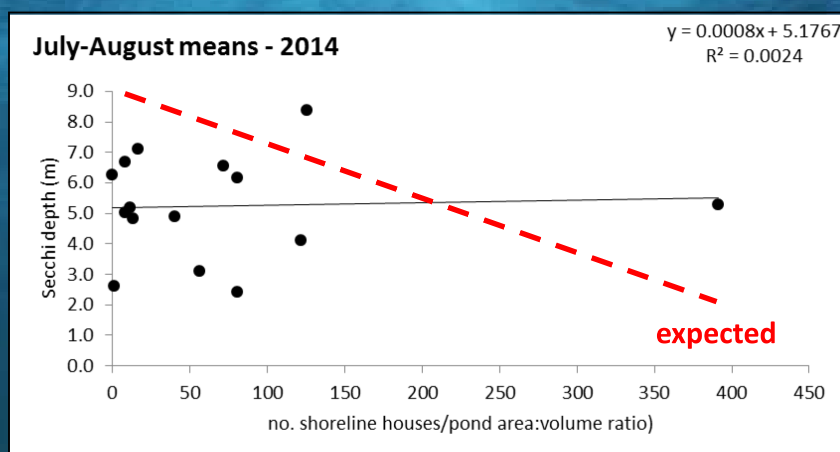
Consequences of pond warming

- **Increased temps can result in increased algal productivity**
- **Stronger thermocline = less vertical mixing** in summer and therefore more **limited nutrient availability** in photic zone (seasonally enhanced oligotrophy) **OR** algae may be able to take advantage of **nutrients just below thermocline at shallower depths** where there is more light
- Such changes elsewhere have been shown to alter **algal structure, seasonal patterns of productivity, and taxonomy**
- In many cases, lake warming has led to, or is predicted to lead to, increased dominance of **cyanobacteria** (blue-green algae, which can be toxic)
- In some cases greater abundances of dinoflagellates and large chrysophytes are favored by higher temperatures **– alters quality of food for higher organisms**
- There may also be changes in the **suitability of various thermal habitats** for individual fish taxa

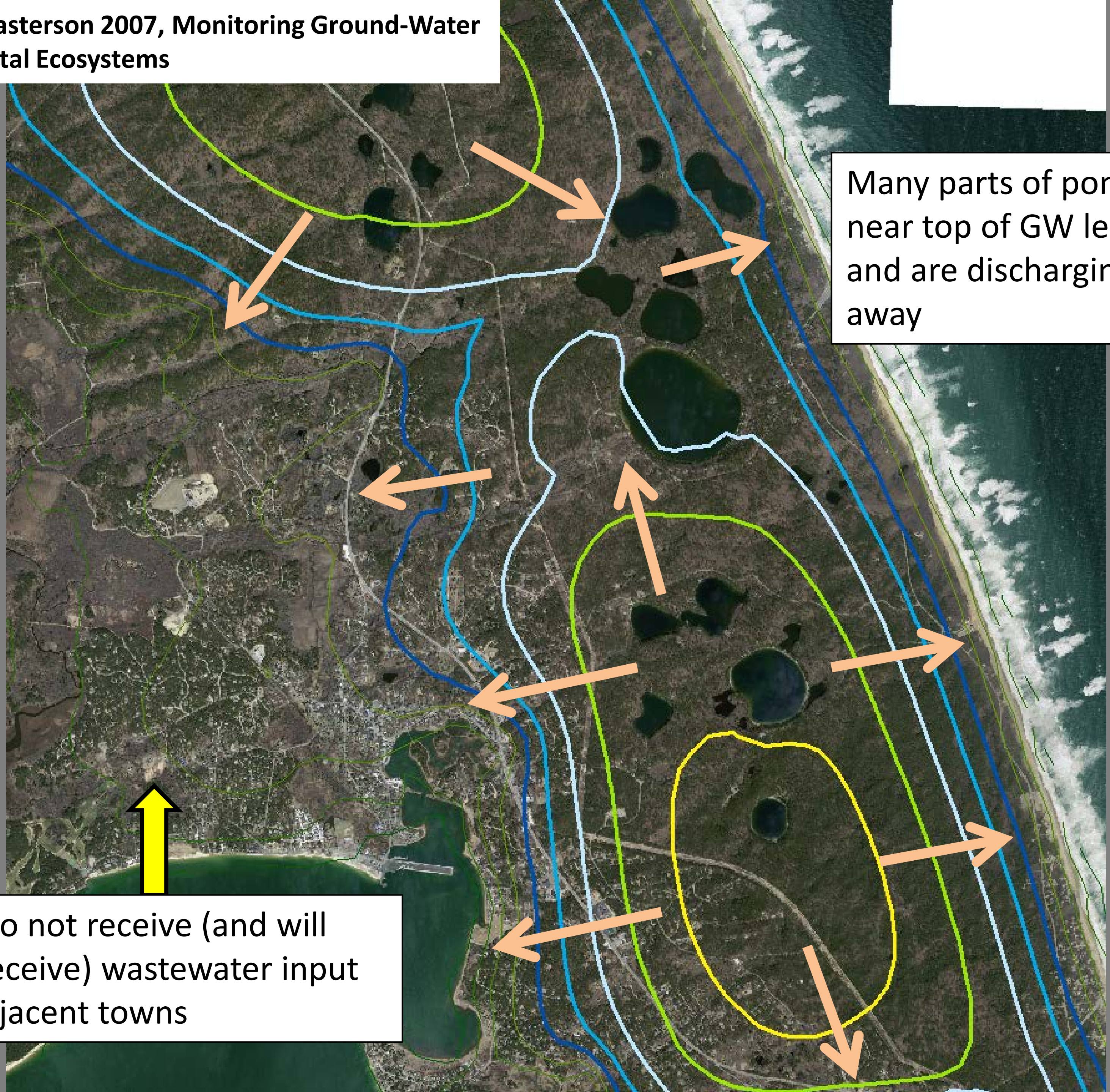
Other issues related to the 'state of our ponds'

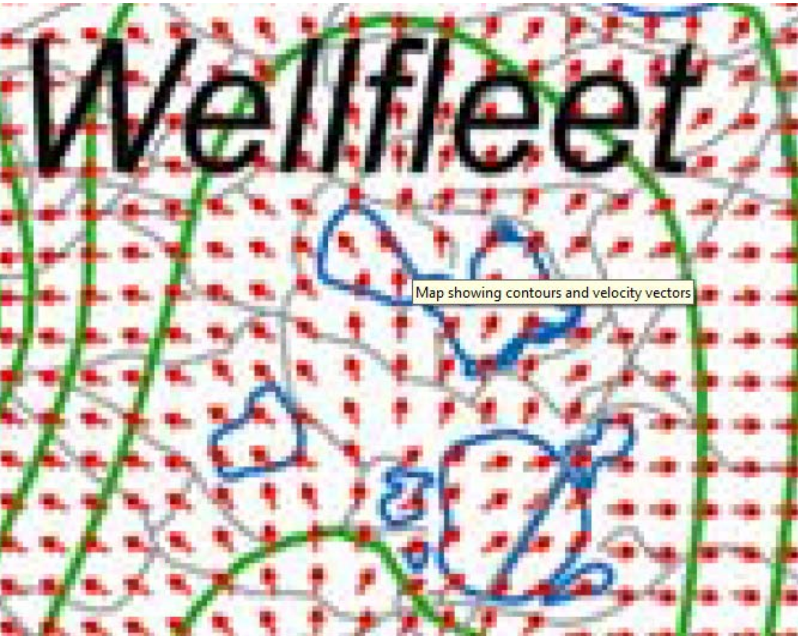
In CACO there is no correlation between Secchi depth (clarity) and level of 'development'





Colman and Masterson 2007, Monitoring Ground-Water Quality in Coastal Ecosystems

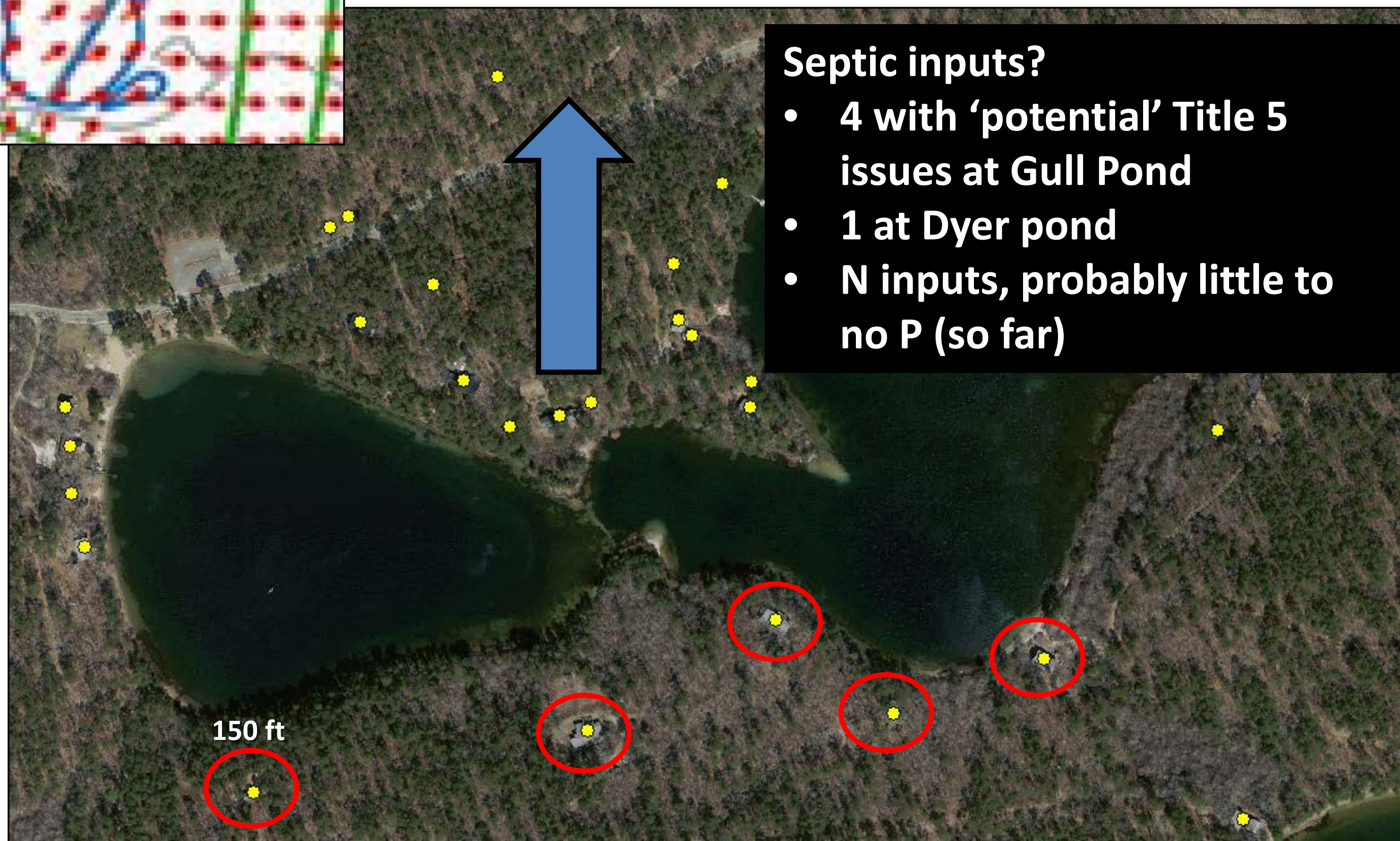




Ponds receive septic inputs from only some of surrounding structures

Colman and Masterson 2007, Monitoring Ground-Water Quality in Coastal Ecosystems

Pond	No structures-inflow
Duck	0
Dyer	1
Great_T	2
Great_W	1
Gull	27
Higgins	6
Horseleech	0
Kinnacum	0
Long	6
Round_E	3
Round_W	2
Ryder	10
Slough	6
Snow	0
Spectacle	0



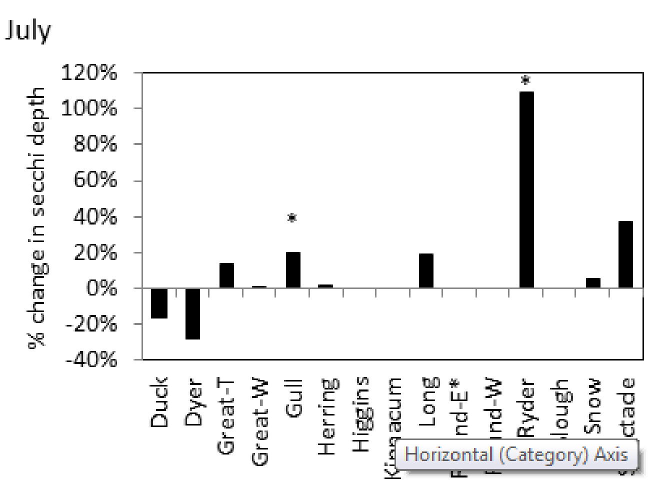
Septic inputs?

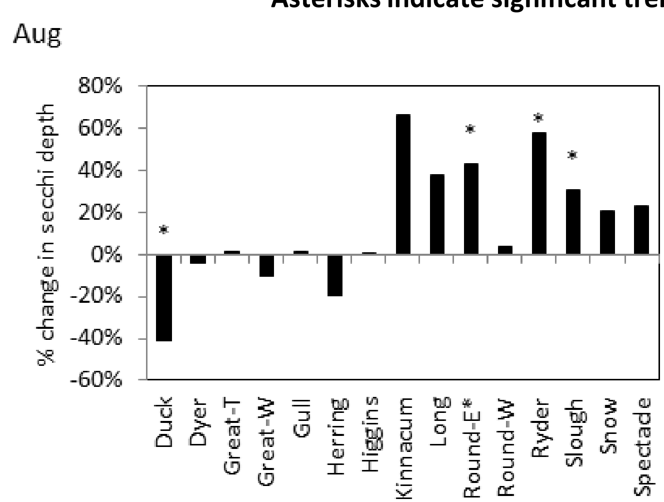
- 4 with 'potential' Title 5 issues at Gull Pond
- 1 at Dyer pond
- N inputs, probably little to no P (so far)

Summer secchi depth trends by pond

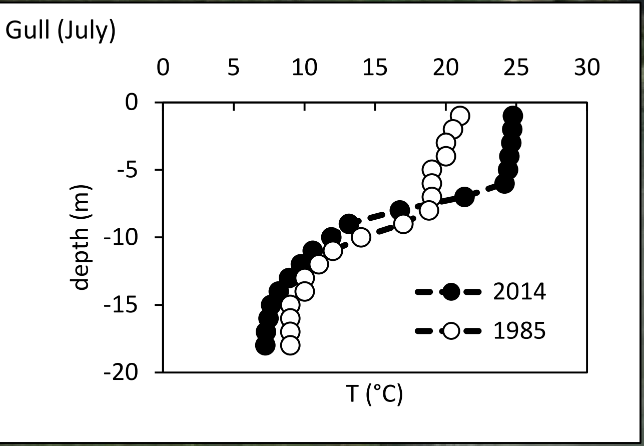
	July				August			
	R_2	p	change	% change	R_2	p	change	% change
Duck	0.04	0.42	-1.1	-16%	0.30	0.02	-2.9	-41%
Dyer	0.13	0.13	-1.9	-28%	0.00	0.83	-0.2	-4%
Great-T	0.05	0.36	0.7	13%	0.00	0.91	0.1	1%
Great-W	0.00	0.96	0.0	1%	0.05	0.36	-0.7	-10%
Gull	0.22	0.04	1.2	20%	0.00	0.90	0.1	1%
Herring	0.00	0.91	0.1	2%	0.05	0.35	-0.4	-19%
Higgins	-	-	-	-	0.00	0.97	0.0	1%
Kinnacum	-	-	-	-	0.16	0.11	1.0	66%
Long	0.07	0.28	1.2	19%	0.15	0.11	2.1	37%
Round-E*	-	-	-	-	0.66	0.00	2.3	43%
Round-W	-	-	-	-	0.00	0.84	0.2	4%
Ryder	0.63	<.0001	4.3	109%	0.32	0.01	2.4	58%
Slough	-	-	-	-	0.44	0.01	1.5	31%
Snow	0.01	0.78	0.2	5%	0.06	0.32	0.9	20%
Spectacle	0.16	0.06	1.7	37%	0.05	0.33	1.1	23%

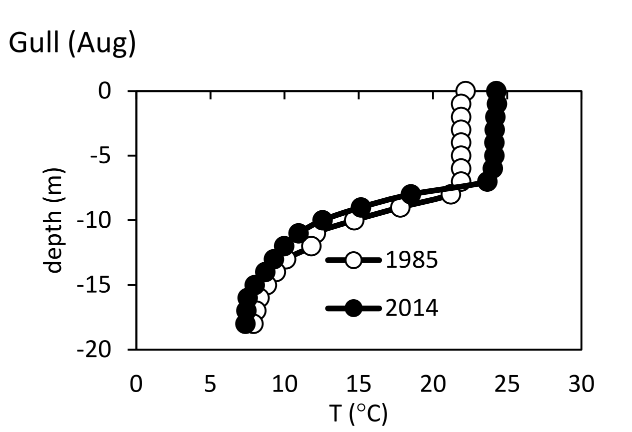
*** Asterisks indicate significant trend**

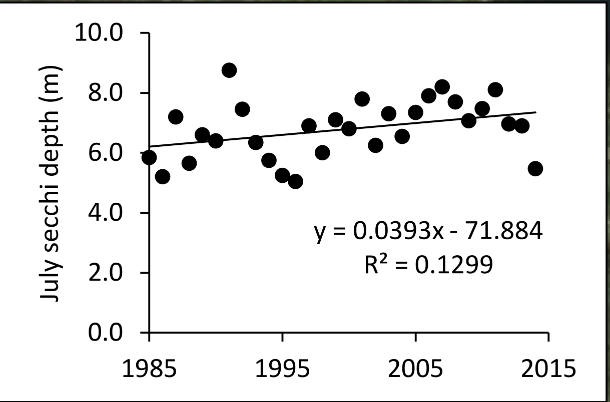


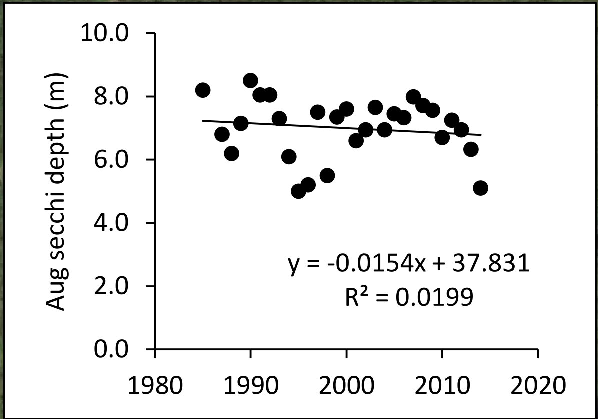


Gull Pond summer Secchi depths (1996-2014)





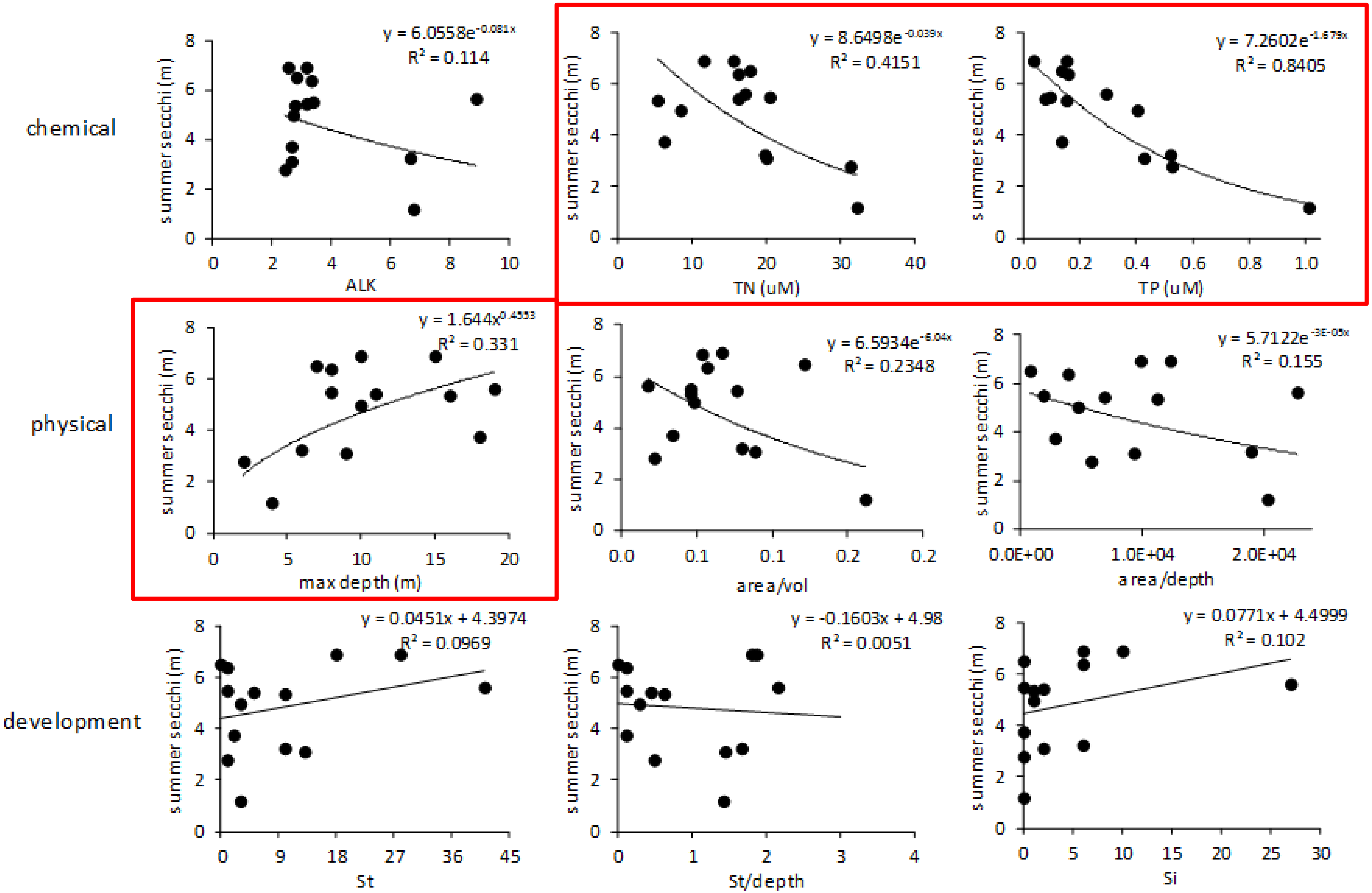




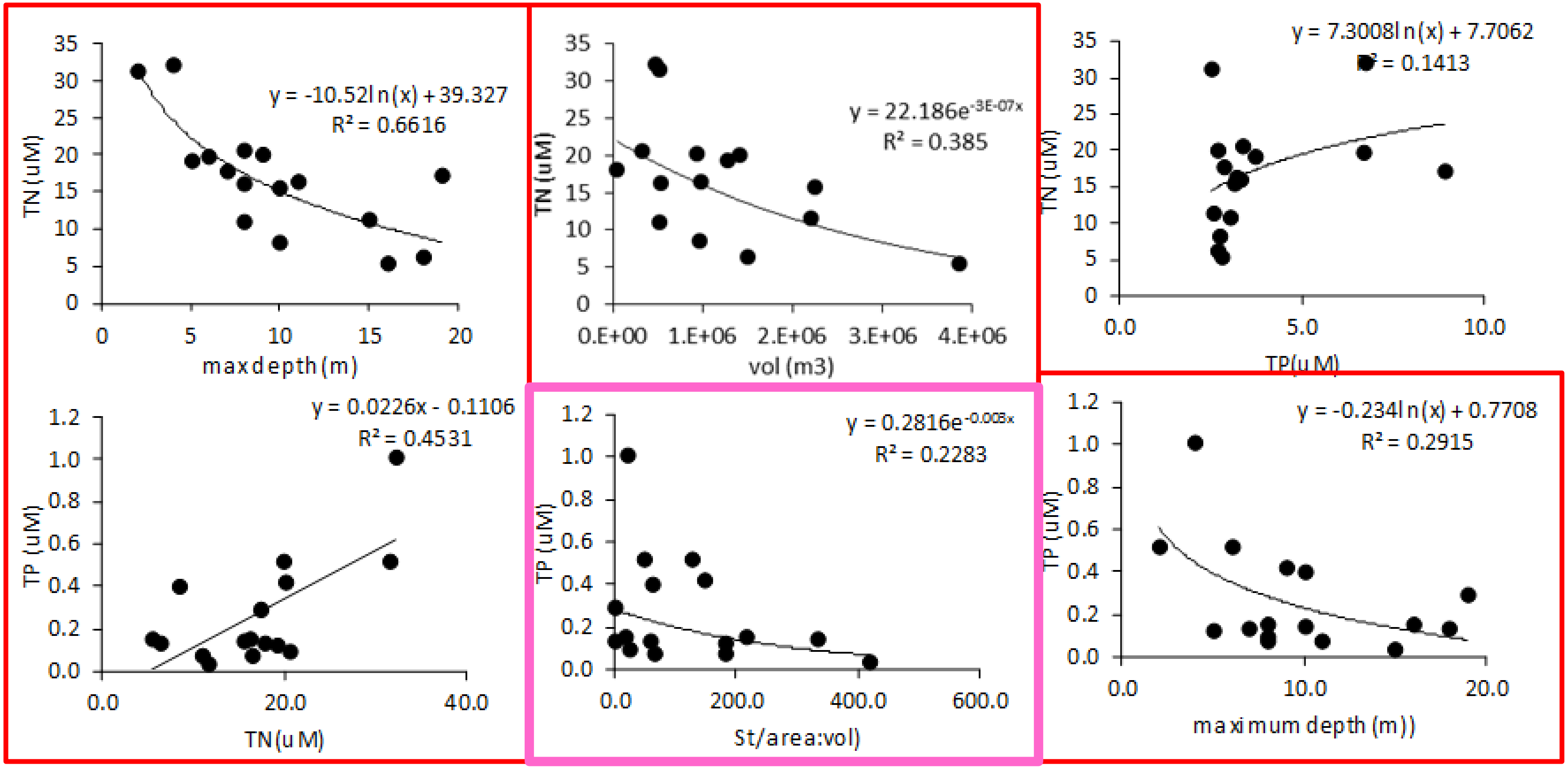
How can thermocline be getting shallower but water clarity increasing in many cases?

- Algal taxa that like temperatures cooler than what is available at the surface now are moving downward
- Taxa that grow best in slightly lower light conditions are moving downward to areas of lower light
- Sub-thermocline chlorophyll maxima are common in many (often oligotrophic) systems – has the effect of increasing water clarity to a certain extent
- Relationship between algal biomass, algal species composition, algal chlorophyll:biomass , vertical temperature profiles, nutrient concentrations, light attentuation, zooplankton grazing pressure, etc. VERY complex

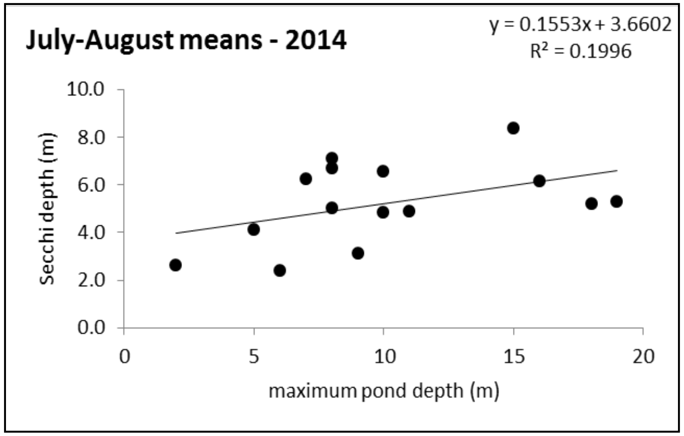
Pond summer Secchi depths vs. chemical, physical, developmental variables

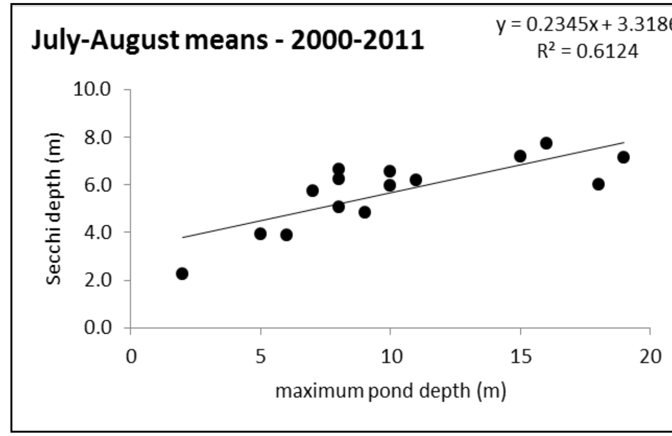


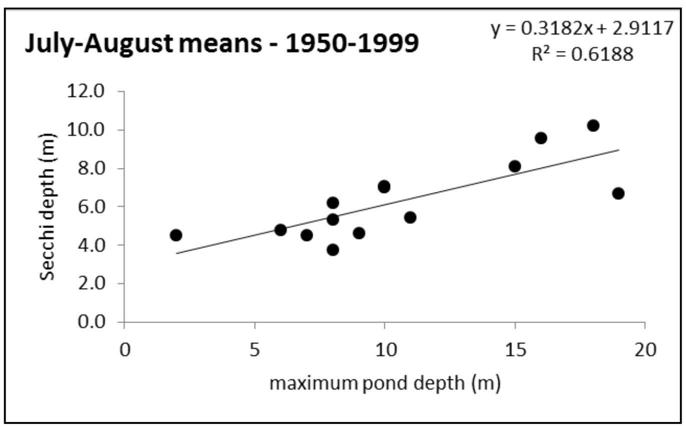
Nutrient concentrations vs. physical and developmental variables

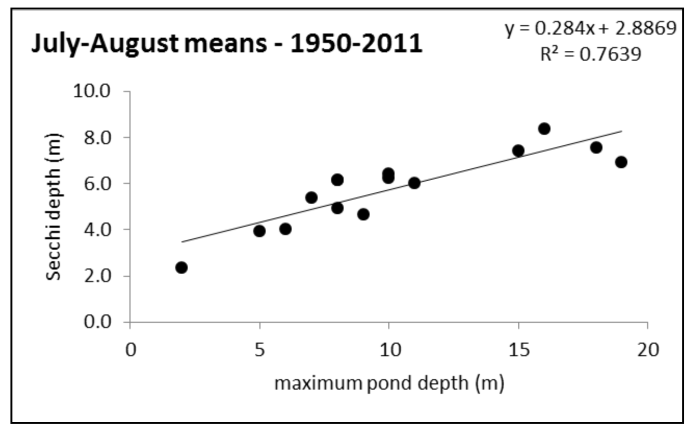


Best correlation of pond Secchi depth is with maximum pond depth; this is true CAPE WIDE





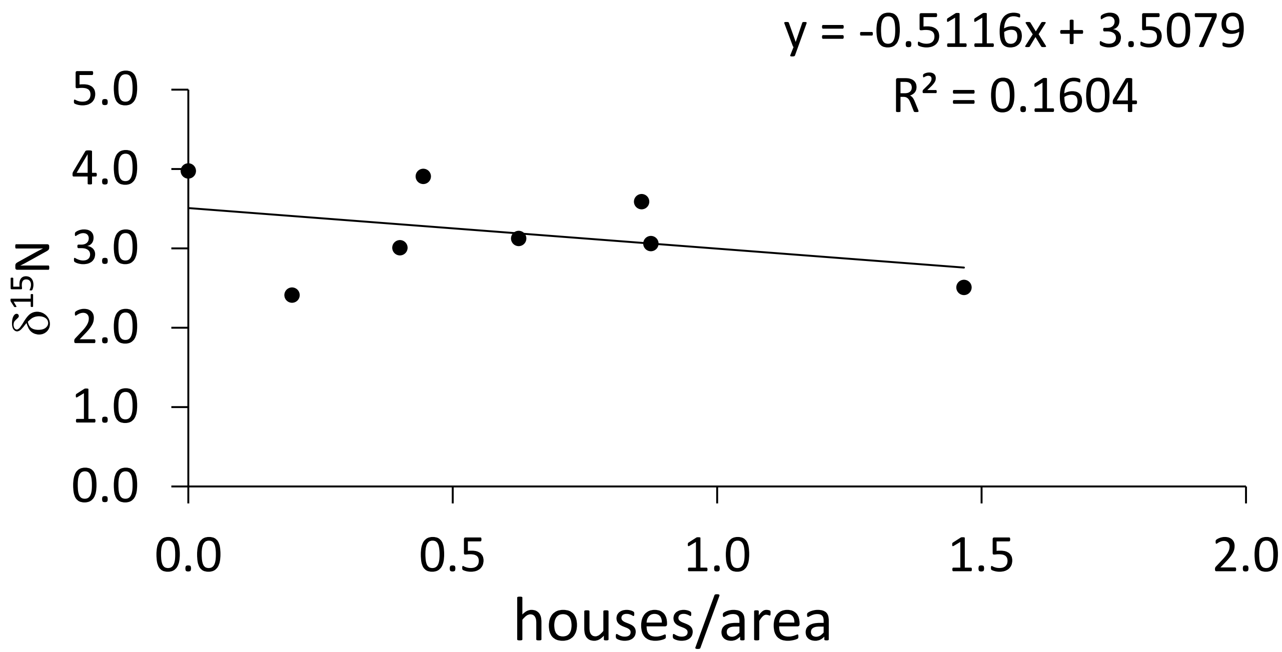




Shallower ponds often have reduced water clarity due to higher vertical mixing capacity, nutrient and sediment suspension (established concept)

*** <u>Physical attributes</u> and climate-related factors most responsible for CACO pond trophic state;**

δ^{15}N is an indicator of wastewater input – no relationship with level of development around CACO ponds



Johnson and Shmagin (2006) – Minnesota lakes

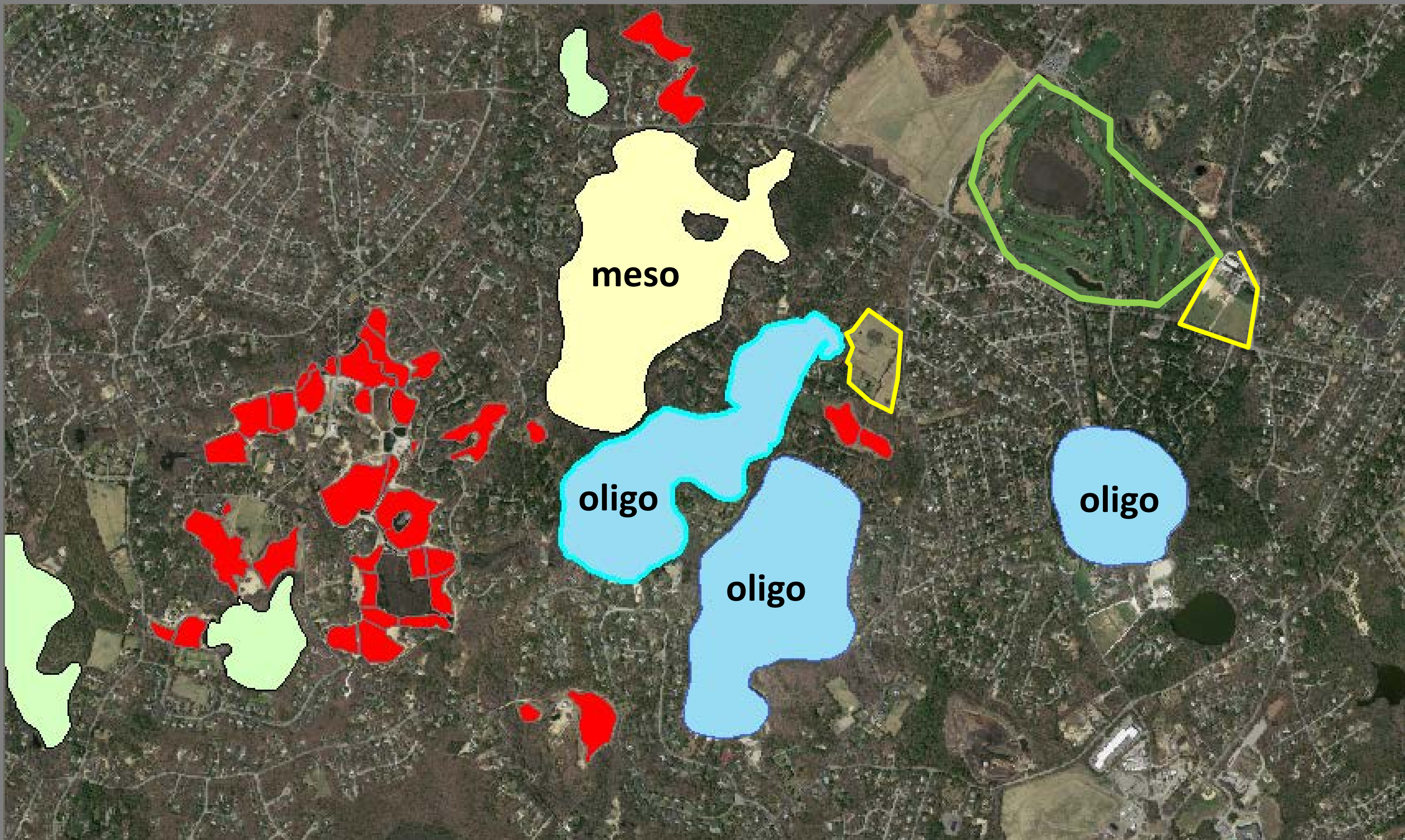
16.3 RESULTS

16.3.1 Univariate Relationships between Development and Secchi Transparency

Secchi transparency ranged widely within the NLF ecoregion, from 0.6 to nearly 12 m. Lakes also varied widely in degree of development, with human populations ranging from 0 to 5,754 people in the shoreland zone. However, there were no significant correlations between development-related variables and lake transparency, with the exception of mining in the shoreland zone (BUFMIN), which was associated with clearer lakes in data set III (r = 0.181) but not data set II (r = 0.030). This relationship was affected by the fact that three of the clearest lakes in data set III were mine pit lakes, with transparencies exceeding 7.8 m: Tioga Mine Pit, Sabin Lake, and the Judson Mine Pit. These lakes were not part of the 1977-79 data set.

An unexpected result was that lakes with people living around them were significantly *clearer* than those without (t = 1.98, P = 0.048). Mean Secchi depth for lakes with people (n = 417) was 3.26 m, and mean Secchi depth for those without (n = 172) was 2.97 m. Maximum lake depth was also significantly greater for populated than unpopulated lakes, averaging 11.1 m for unpopulated lakes and 14.5 m for populated lakes (t = 3.82, P = 0.000). This difference in maximum lake depth, rather than the presence or absence of people *per se*, may explain why the populated lakes were clearer than unpopulated lakes. There is also the possibility of self-selection, in that people prefer to live on clearer lakes.

Pond trophic state circumstances that are counterintuitive



Nickerson State Park – has always been undeveloped

Mesotrophic/Eutrophic with frequent blue-green algal blooms that have closed the pond to swimmers in the past

That said….

- Anthropogenic nutrient inputs are deleterious to ponds
- It may be that there is significant phosphorus that has yet to reach the ponds as this nutrient moves very slowly through groundwater
- Everything possible should be done to limit nutrient inputs in order to preserve trophic state
- Intact shoreline and littoral vegetation extremely important in assimilating nutrients so that they do not impact open water

Internal factors besides physical attributes: Fish stocking on Cape Cod since 1920s - Gull and Great-T ponds are stocked with non-native trout

Energy and Environmental Affairs

Trout Stocking Report

This NEW stocking report provides anglers with a table *or* a map to view trout stocking information, now updated daily!

View Map | How It Works | More Stocking Information

Waterbody [ ] Town [wellfleet] District [ ]

Stocking Date	Waterbody	Town	Species	District
4/8/2016	Gull Pond	WELLFLEET	Eastern Brook Trout	Southeast
4/4/2016	Gull Pond	WELLFLEET	Brown Trout	Southeast
3/28/2016	Gull Pond	WELLFLEET	Rainbow Trout	Southeast
3/17/2016	Gull Pond	WELLFLEET	Rainbow Trout	Southeast
3/9/2016	Gull Pond	WELLFLEET	Rainbow Trout	Southeast

Fish stocking shown to increase algae growth in other oligotrophic lake systems

Ecosystems (2001) 4: 308–321
DOI: 10.1007/s10021-001-0013-4

ECOSYSTEMS

Alteration of Nutrient Cycles and Algal Production Resulting from Fish Introductions into Mountain Lakes

Daniel E. Schindler,[1]* Roland A. Knapp,[2] and Peter R. Leavitt[3]

[1]Department of Zoology, University of Washington, Box 351800, Seattle, Washington 98195-1800, USA; [2]Sierra Nevada Aquatic Research Laboratory, University of California, Star Route 1, Box 198, Mammoth Lakes, California 93546, USA; and [3]Limnology Laboratory, Department of Biology, University of Regina Regina, Saskatchewan Canada, S4S 0A2

Abstract

The introduction of salmonid fishes into naturally fishless lakes represents one of the most prevalent environmental modifications of aquatic ecosystems in western North America. Introduced fish may alter lake nutrient cycles and primary production, but the magnitude and variation of these effects have not been fully explored. We used bioenergetics modeling to estimate the contributions of stocked trout to phosphorus (P) cycles across a wide range of fish densities in lakes of the Sierra Nevada, California. We also assessed the larger effects of fish-induced changes in phosphorus cycling on primary production using paleolimnological analyses from lakes in the southern Canadian Rockies. Our analyses showed that total P recycling by fish was independent of fish density but positively related to fish biomass in the Sierra Nevada. In lakes with fish populations maintained by continued stocking, fish recycled P at over twice the rate of those in lakes where introduced fish populations are maintained by natural reproduction and stocking has been discontinued. We estimate that P regeneration by introduced fishes is approximately equivalent to atmospheric P deposition to these lakes. Paleolimnological analyses indicated that algal production increased substantially following trout introductions to Rocky Mountain lakes and was maintained for the duration of fish presence. The results of our modeling and paleolimnological analyses indicate that introduced trout fundamentally alter nutrient cycles and stimulate primary production by accessing benthic P sources that are not normally available to pelagic communities in oligotrophic mountain lakes. These effects pose a difficult challenge for managers charged with balancing the demand for recreational fisheries with the need to maintain natural ecosystem processes.

Key words: algal production; exotic species; introduced species; fishless lakes; nutrient cycles; paleolimnology; phosphorus; Rocky Mountains; Sierra Nevada; fish stocking.

*** What will be the implications of increased numbers of fish in Herring, Higgins, Williams, and Gull Ponds after restoration of the Herring River?**

Fossil Pigment Records of Phytoplankton in Trout-stocked Alpine Lakes

P. R. Leavitt, D. E. Schindler, A. J. Paul, A. K. Hardie, D. W. Schindler

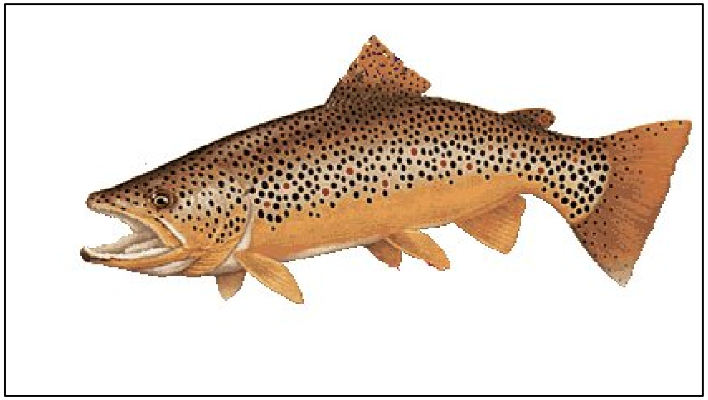
PDF (1412 K)
PDF-Plus (1507 K)
Citing articles

Published on the web 12 April 2011.

Canadian Journal of Fisheries and Aquatic Sciences, 1994, 51(11): 2411-2423, 10.1139/f94-241

ABSTRACT

Paleolimnology, bioenergetics modelling, and mesocosm experiments were used to quantify changes in phytoplankton following introduction of trout into fishless alpine lakes in the Canadian Rocky Mountains. During the 1960s, Snowflake and Pipit lakes were stocked with brook (*Salvelinus fontinalis*), cutthroat (*Oncorhynchus clarkii*) and rainbow trout (*O. mykiss*) either singly or in combination. Stocked trout eliminated large invertebrates (*Daphnia* spp., *Hesperodiaptomus arcticus*, *Gammarus lacustris*), but the fish died within 15 yr. High performance liquid chromatographic analysis of carotenoids and chlorophylls in sediments inferred that algal abundance increased 4- to 10-fold shortly after fish stocking. In contrast, phytoplankton composition and biomass were constant in nearby, unstocked Harrison Lake, as inferred from fossils. Pigment analysis of mesocosms showed that phytoplankton were sensitive to moderate fertilization: 11 µg $P \cdot L^{-1}$ resulted in four- to six-fold increases in algal biomass. Bioenergetics modelling was used to estimate phosphorus (P) excretion from trout. The flux of excreted P was highly correlated ($r^2 = 0.76$, $p < 0.0001$, $N = 12$) to changes in algal biomass, as estimated from fossil pheophytin *b*. Consequently, we infer that nutrient recycling by stocked trout was one of several mechanisms that contributed to increased algal biomass.

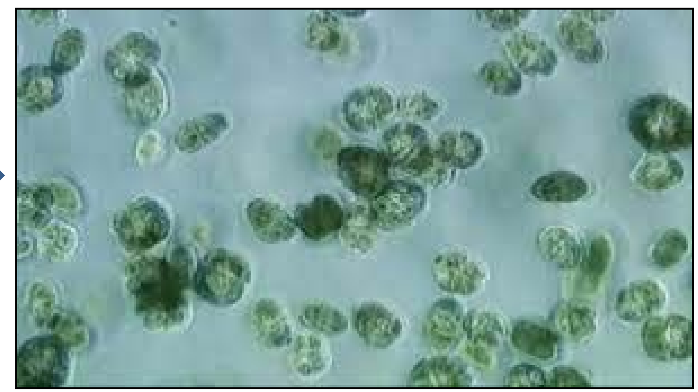


Adding organic matter and altering food web dynamics, including grazers of algae

−

Zooplankton and aquatic insects

+



algae

GULL POND
Wellfleet

Barnstable County
Cape Cod Watershed
Latitude: 41.9561047 N Longitude: 70.0083229 W

109 Acres
Depth: 31 feet Average
64 Feet Maximum
Principle Gamefish:
Trout, Smallmouth Bass

General Information:

Great Pond is a 109 acre natural kettlehole pond with an average depth of 31 feet and a maximum depth of 64 feet. Transparency is exceptional, extending to 25 feet. The bottom is composed primarily of sand. Aquatic vegetation is scarce. The 1.4 miles of shoreline are forested and lightly developed. The shape of Gull Pond is typical of the rounded outline of kettlehole ponds.

Access:

Gull Pond is located in the northeast section of Wellfleet within the Cape Cod National Seashore. From Route 6 (heading north) take a right onto Gull Pond Road, travel about one mile, then take a left onto Schoolhouse Hill Road. The access road to the town landing is on the right. Parking is available at the town beach area. The access is suitable for launching small boats and canoes*, access may be limited during the peak beach hours during the summer.* The solid bottom along the shoreline is well suited to wading. ***No outboards are allowed, although the use of electric motors is permitted.***

Management History:

Gull Pond was first surveyed in 1901 and 1912 and contained pickerel, white and yellow perch and alewives. In 1917-1918, over one million smelt eggs were stocked into the pond. White perch, yellow perch and smallmouth bass were stocked in the 1920's and 1930's. An August 24, 1948 fisheries survey found white perch, white suckers, pumpkinseeds, yellow perch, smallmouth bass and alewives. Gull Pond was recommended for trout management and since 1949 Gull Pond has been stocked with trout. A special brown trout regulation (one brown trout greater than 15 inches minimum length) was in effect from 1995-1998.

Fish Populations:

The last fisheries survey, conducted in 1995 found white sucker, smallmouth bass, brown trout, and brook trout. A 1988 survey found brown trout, rainbow trout, smallmouth bass, white perch, yellow perch, white sucker and alewife. A 1982 survey also found largemouth bass, American eel, banded killifish and pumpkinseed sunfish. The pond supports a population of sea-run alewives which enter it after travelling up the Herring River to Herring Pond, and from there to Higgins Pond. A small ditch allows the alewives to enter Gull Pond from Higgins Pond.

Fishing:

Gull Pond is annually stocked in the spring with rainbow, brown and brook trout. It produces some excellent holdover trout every year, especially brown trout. The 1988 survey, conducted in the fall, recorded a 28 inch brown trout that weighed a little over 14 pounds! The production of these large holdover trout is due to the pond's excellent coldwater trout habitat combined with a good forage base in the form of sea-run alewives. During high summer, look for the trout at depths of 31 to 42 feet. This is also a good smallmouth bass pond, with at least a few large fish always present in the population.

Updated: March 5, 2007 S.T.H.

Artificial structures attract wildlife, which contributes to nutrient loading