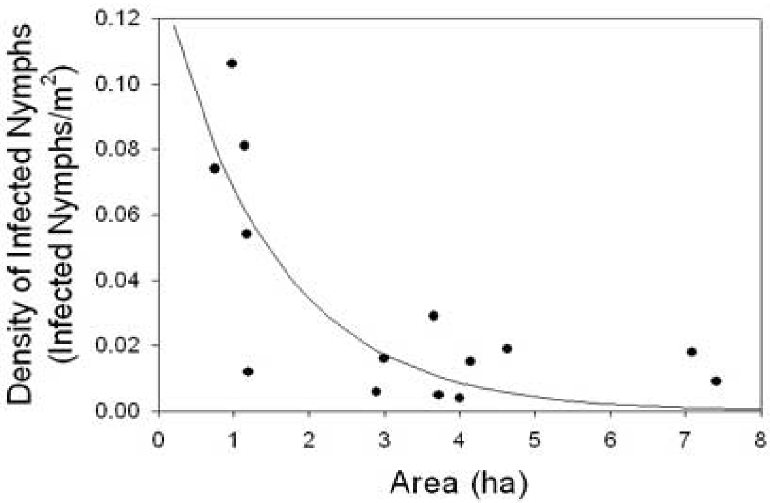
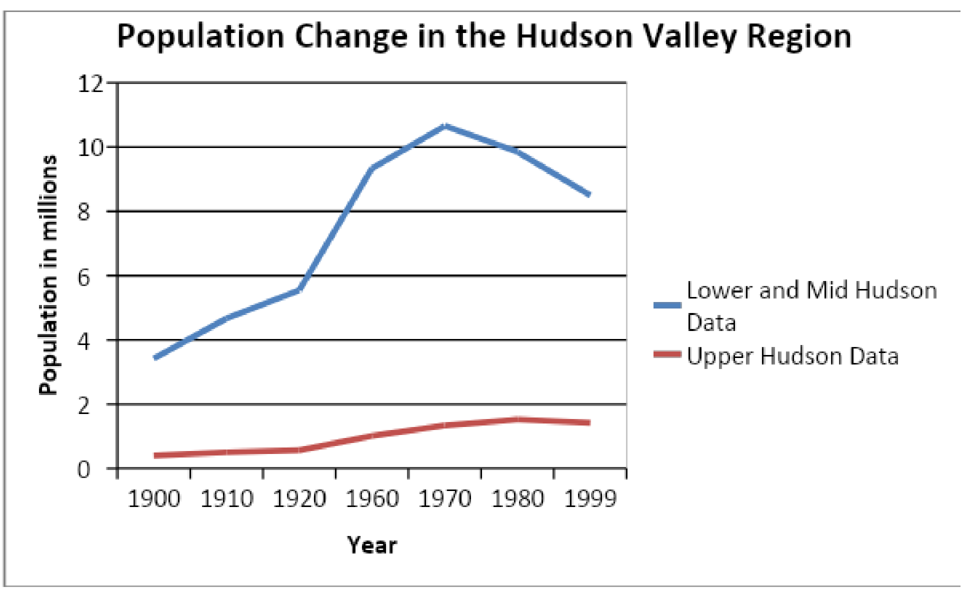
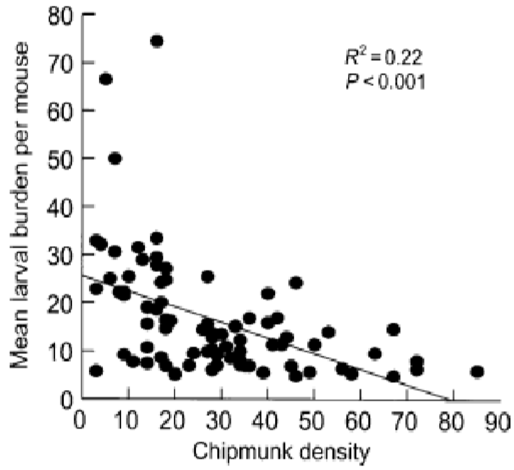
Resource Packet: Group 1



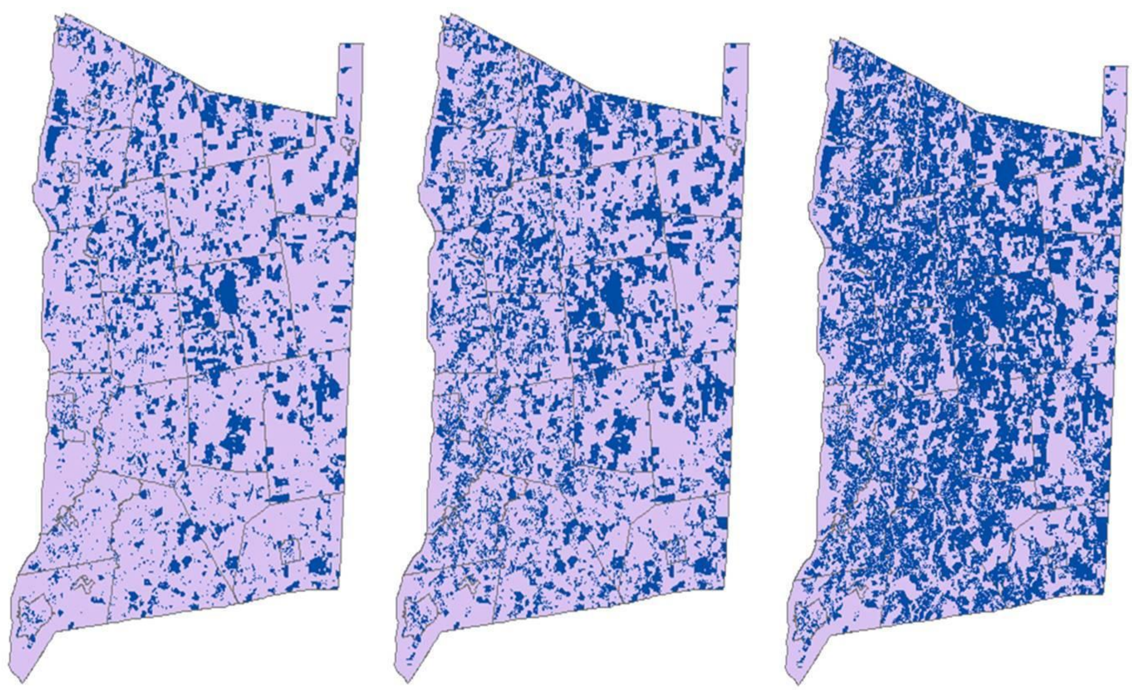
Data from Dutchess County, New York, showing that small forest fragments have elevated Lyme disease risk. From Allan et al. 2003.



Data from Brosnan, T.M, Stoddard, A., and L.J. Hetling. 2006. Hudson River Sewage Inputs and Impacts: Past and Present in J. S. Levinton and J.R. Waldman (Eds.) The Hudson River Estuary; New York: Cambridge Press.

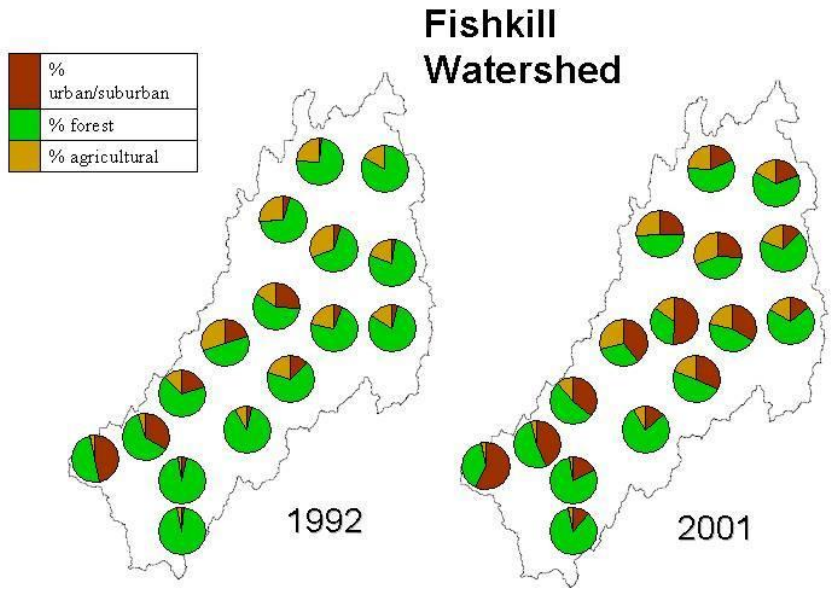


In years of low chipmunk amounts, tick numbers on mice were variable. But, in years of high chipmunk density, tick burdens on mice were always low. This suggests that when there are lots of alternative hosts (including chipmunks, rats, moles, voles) for the ticks, it reduced the rates of encounter between the ticks and the white-footed mice. White-footed mice are the most common and competent reservoir for the Lyme disease bacterium. Consequently, the more diverse the population of animals in the forest, the lower the rate of Lyme disease infected mice. Keesing, F., R. D. Holt, and R. S. Ostfeld. 2006. Effects of species diversity on disease risk. *Ecology Letters,* 9:485-498.



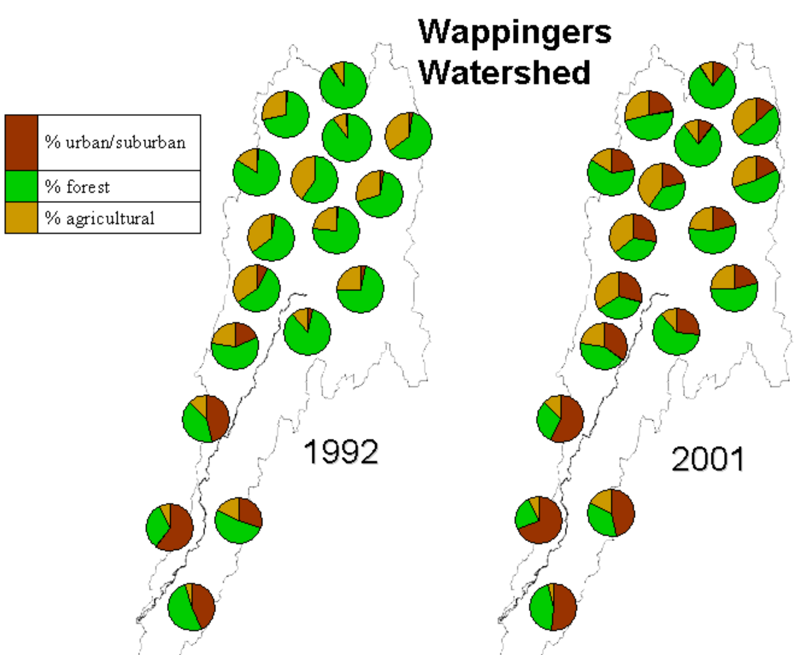
1940 1970 2004

Dutchess County Built Tax Parcels, courtesy of K. Menking & M.A. Cunningham, Vassar College. Built tax parcels refer to all the land that is used for buildings for which the county receives tax payments. The blue color is the built portions of the county.



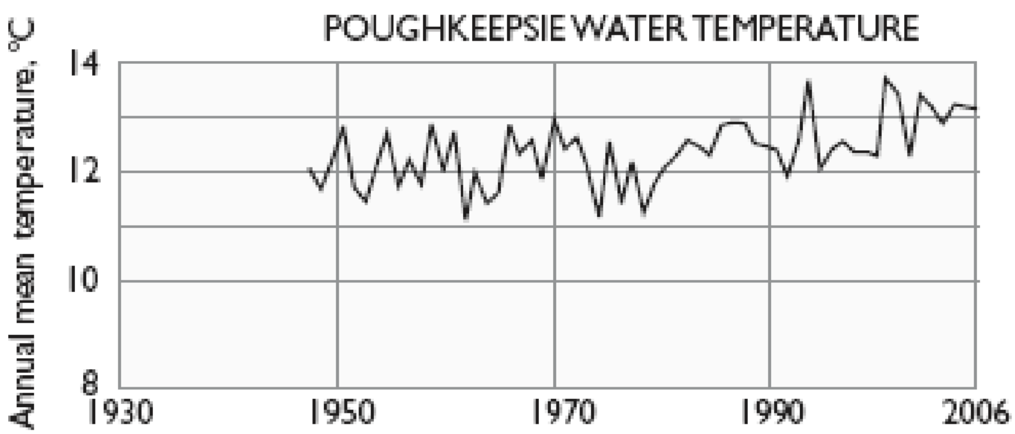
Source: K. Limburg

The Fishkill watershed is in the Hudson Valley. It drains most of Fishkill, East Fishkill, Beekman, Unionvale, Lagrange, parts of Beacon, Philipstown, and Wappinger.

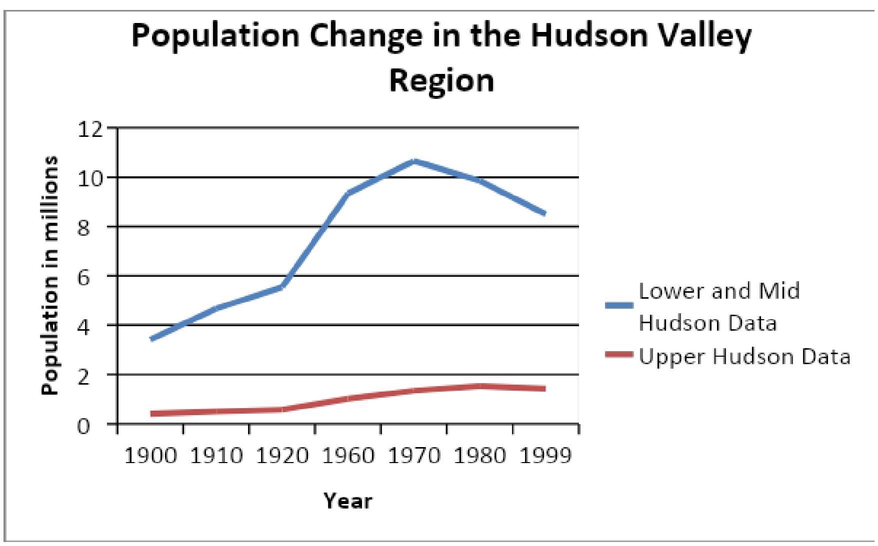


The Wappinger watershed is also in the Hudson Valley. It drains a large portion of Dutchess County, including Wappinger, parts of the town of Poughkeepsie, Millbrook, Pleasant Valley, Stanfordville, and a few others.

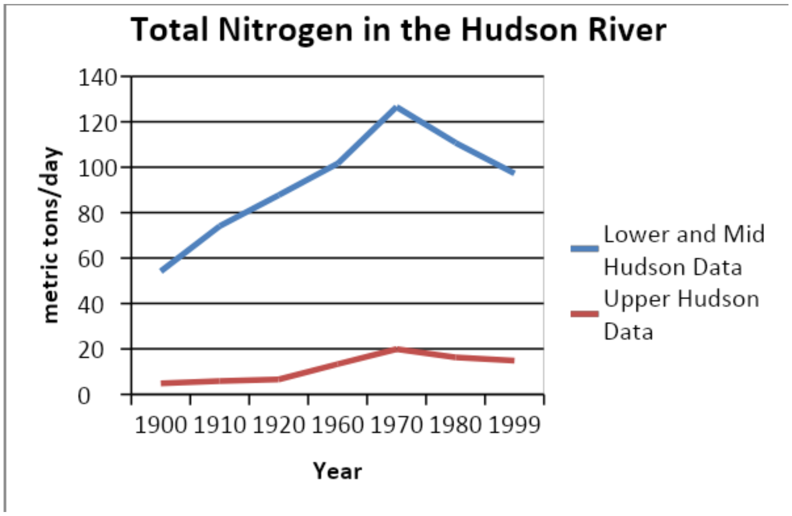
<u>Resource Packet: Group 2</u>

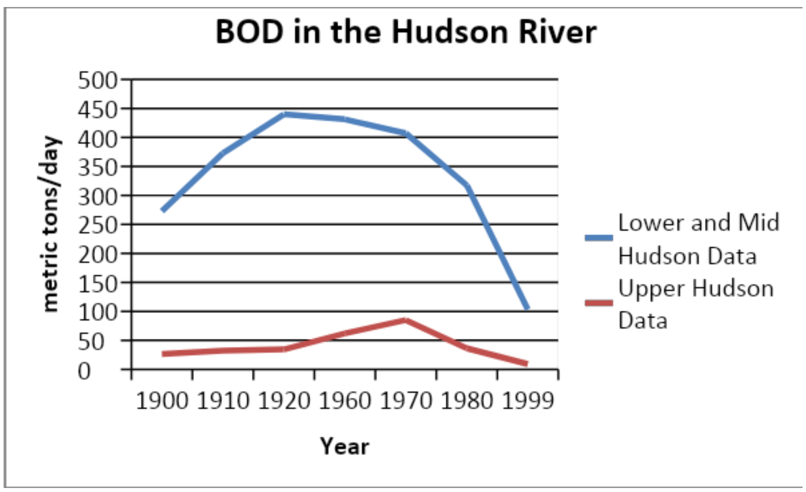


Seekell, D.A., and M.L. Pace. Analysis of a Warming Trend in the Hudson River Estuary. *Estuaries and Coasts* (submitted ms.)



Data from Brosnan, T.M, Stoddard, A., and L.J. Hetling. 2006. Hudson River Sewage Inputs and Impacts: Past and Present in J. S. Levinton and J.R. Waldman (Eds.) The Hudson River Estuary; New York: Cambridge Press.


Total Nitrogen in the Hudson River
metric tons/day
140
120
100
80
60
40
20
0
1900 1910 1920 1960 1970 1980 1999
Year
Lower and Mid Hudson Data
Upper Hudson Data


BOD in the Hudson River
metric tons/day
500
450
400
350
300
250
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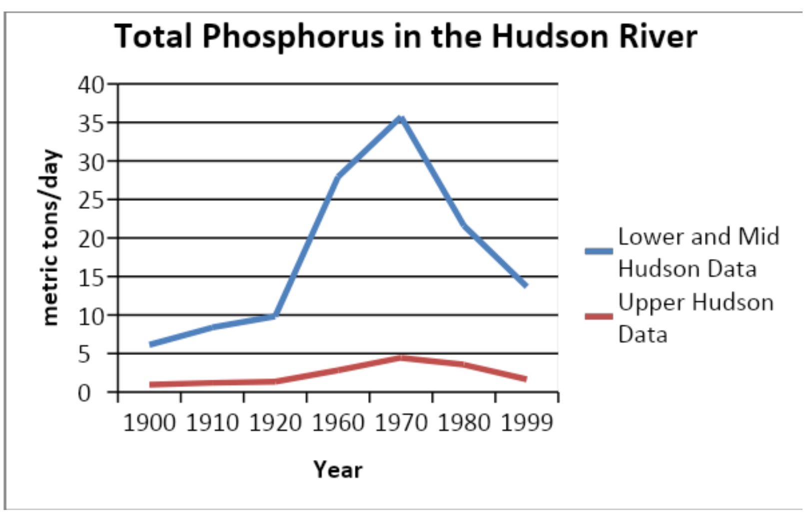
0
1900 1910 1920 1960 1970 1980 1999
Year
Lower and Mid Hudson Data
Upper Hudson Data


Total Phosphorus in the Hudson River
metric tons/day
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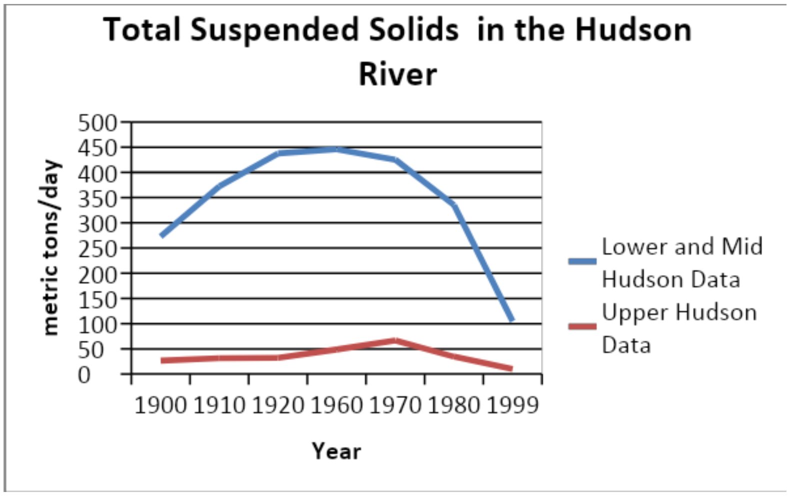
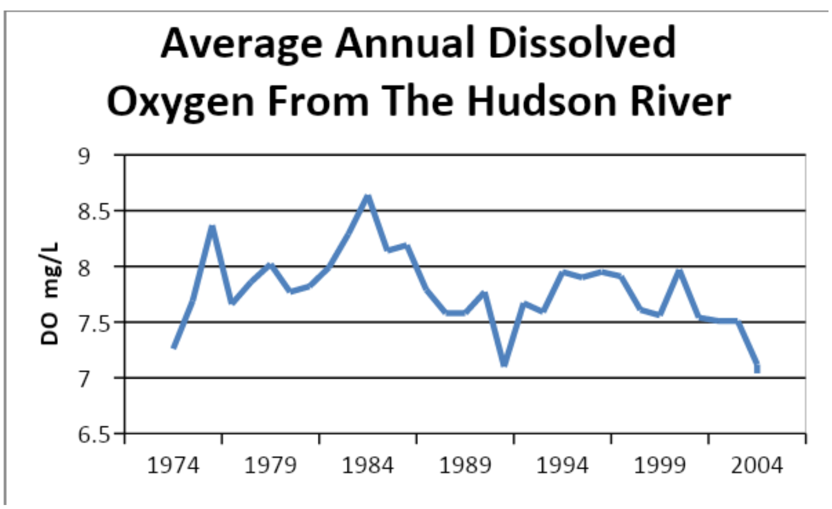
35
30
25
20
15
10
5
0
1900 1910 1920 1960 1970 1980 1999
Year
Lower and Mid Hudson Data
Upper Hudson Data

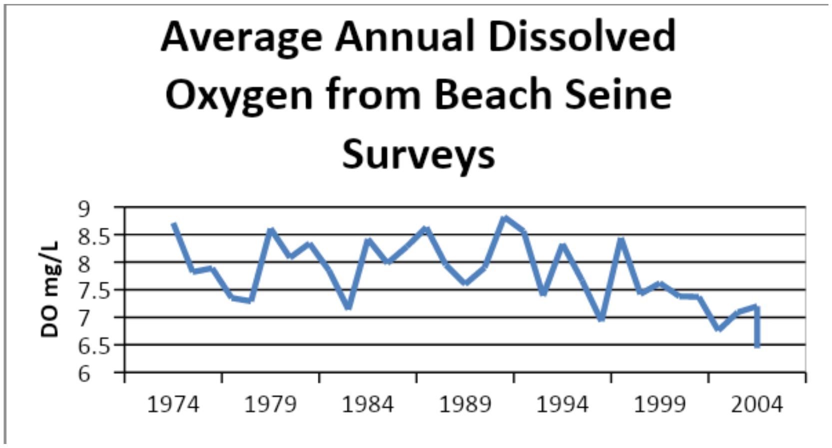
Data from Brosnan, T.M, Stoddard, A., and L.J. Hetling. 2006. Hudson River Sewage Inputs and Impacts: Past and Present in J. S. Levinton and J.R. Waldman (Eds.) The Hudson River Estuary; New York: Cambridge Press.



Data from Brosnan, T.M, Stoddard, A., and L.J. Hetling. 2006. Hudson River Sewage Inputs and Impacts: Past and Present in J. S. Levinton and J.R. Waldman (Eds.) The Hudson River Estuary; New York: Cambridge Press.



Data are annual averages from the Longitudinal River Survey and the Fall Juvenile Survey, 2005 Year Class Report, prepared by ASA Analysis & Communication for Dynegy Roseton L.L.C.



Data are annual averages from Beach Seine Survey, 2005 Year Class Report, prepared by ASA Analysis & Communication for Dynegy Roseton L.L.C.

Once-Through Cooling Impacts on Fishery Resources

The use of the Hudson River to provide once-through cooling water, primarily at stream-electric generating facilities, also impacts fishery resources. Cooling water intake structures often kill fish by impingement on debris screens. But of even greater significance is the entrainment mortality as the water passes through the plant screens, pumps, heat exchanger, and discharge structure. Tens- to hundreds-of-millions of eggs, larvae, and juvenile fishes of several species are killed per year for the large volume, once-through users. The cumulative impact of multiple facilities substantially reduces the young-of-year (YOY) population for the entire river. For example, based on 24 years of study, the September 1 YOY fish populations have been reduced by as much as 25-79% for spottail shiner (1977), 27-63% for striped bass (1986), 52-60% for American Shad (1992), 44-53% for Atlantic tomcod (1985), 39-45% for alewife and blueback herring combined (1992), 30-44% for white perch (1983), and 33% for bay anchovy (1990). (The higher percentage assumes no through-plant survival; the lower number incorporates power company estimate of through-plant survival.)

Species	Year	% reduction - no through-plant survival	% reduction - power plants estimated through-plant survival
Spottail shiner	1977	79	25
Striped bass	1986	63	27
American shad	1992	60	52
Atlantic tomcod	1985	53	44
Alewife and blueback herring combined	1992	45	39
White perch	1983	44	30
Bay anchovy	1990	33	33

From: NYSDEC 2007, New York State Water Quality Report for 2006.

"The Hudson River is home to the only anadromous member of the family Gadidae on the North American Atlantic Coast. A population of Atlantic tomcod is largely contained in the lower tidal portions of the river, surrounding bays of the lower estuary, and in the outer bay and coastal habitats. Historically, tomcod was reported as far south as Virginia (Bigelow and Schroeder 1953), but there are no recent reports of spawning in any drainage south of the Hudson River (Stewart and Auster 1987). The fact that Hudson River tomcod are at the southernmost boundary of the species' spawning distribution may foretell future reductions in its population with warming climate."

-Daniels, R.A., K.E. Limburg, R.E. Schmidt, D.L. Strayer, and R.C. Chambers. 2005. Changes in Fish Assemblages in the Tidal Hudson River, New York. *American Fisheries Society Symposium*, 45:471-503.

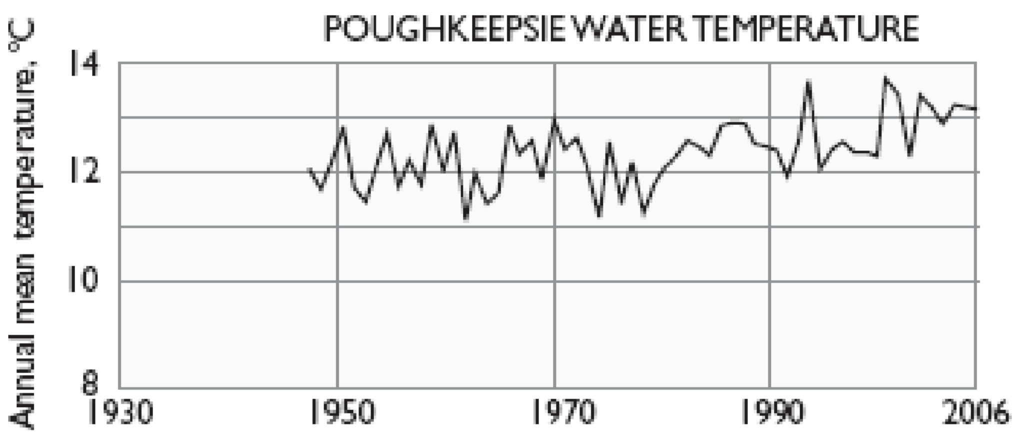
****

Upper Tolerance Limits for Common Hudson Estuary Fish

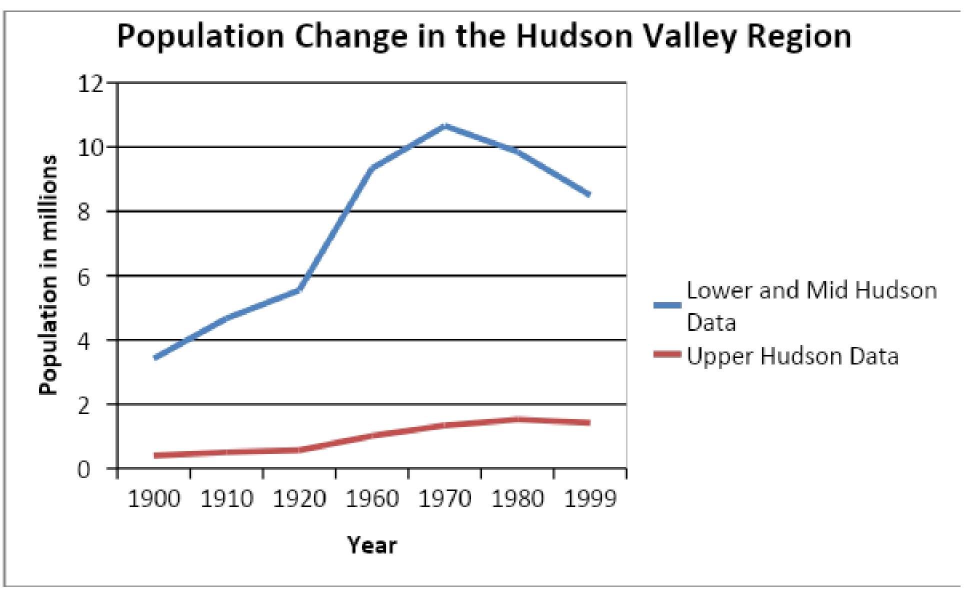
Species	**Latin Name**	**Upper tolerance limit, ˚C**
Carp	*Cyprinus carpio*	31-34
Alewife	*Alosa pseudoharengus*	23
Rainbow Smelt	*Osmerus mordax*	21
Tomcod	*Microgadus tomcod (juveniles)*	19-20.9
Striped bass	Morone saxatilis (yolk sac)	26

-Seaby, R.M.H. and P.A. Henderson. 2008. The Status of Fish Populations and the Ecology of the Hudson. Pisces Conservation Ltd.

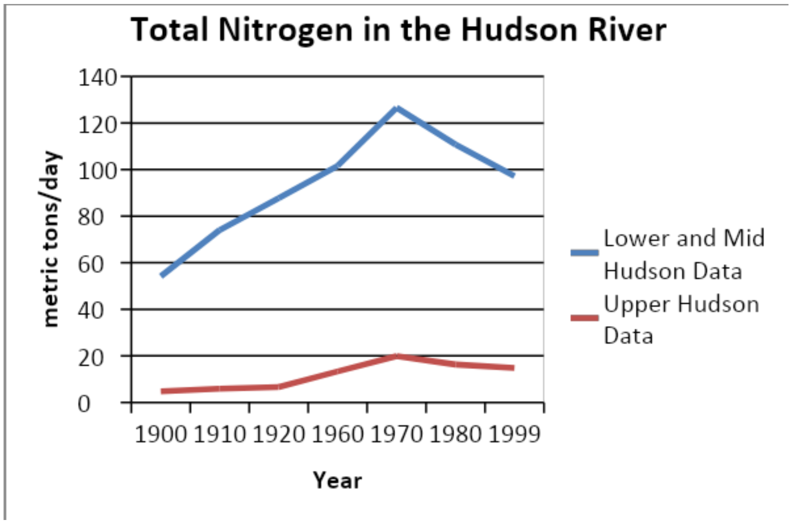
Resource Packe Groupt 3:

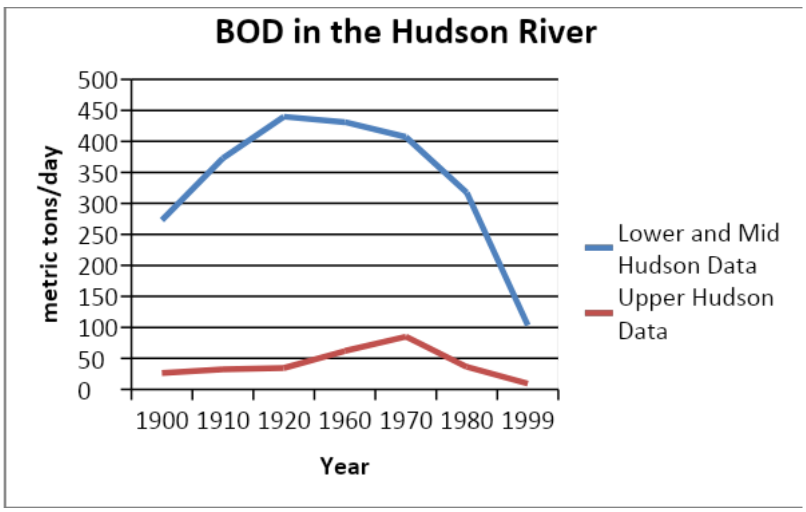


Seekell, D.A., and M.L. Pace. Analysis of a Warming Trend in the Hudson River Estuary. *Estuaries and Coasts* (submitted ms.)



Data from Brosnan, T.M, Stoddard, A., and L.J. Hetling. 2006. Hudson River Sewage Inputs and Impacts: Past and Present in J. S. Levinton and J.R. Waldman (Eds.) The Hudson River Estuary; New York: Cambridge Press.


Total Nitrogen in the Hudson River
metric tons/day
140
120
100
80
60
40
20
0
1900 1910 1920 1960 1970 1980 1999
Year
Lower and Mid Hudson Data
Upper Hudson Data


BOD in the Hudson River
metric tons/day
500
450
400
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300
250
200
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1900 1910 1920 1960 1970 1980 1999
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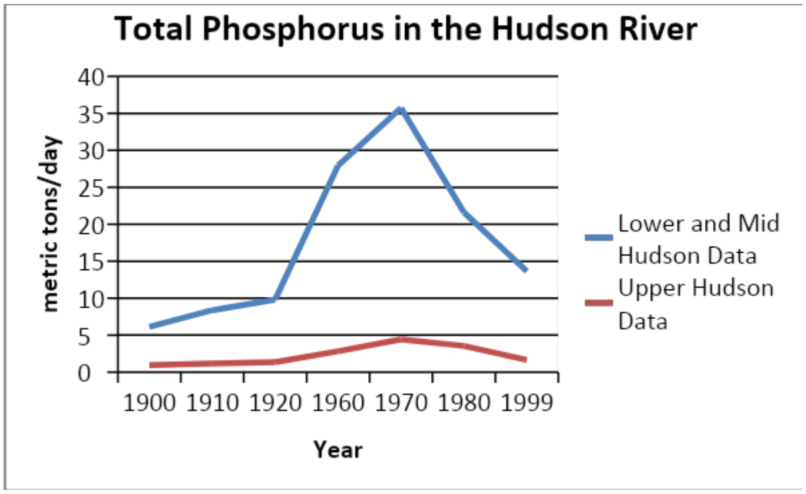
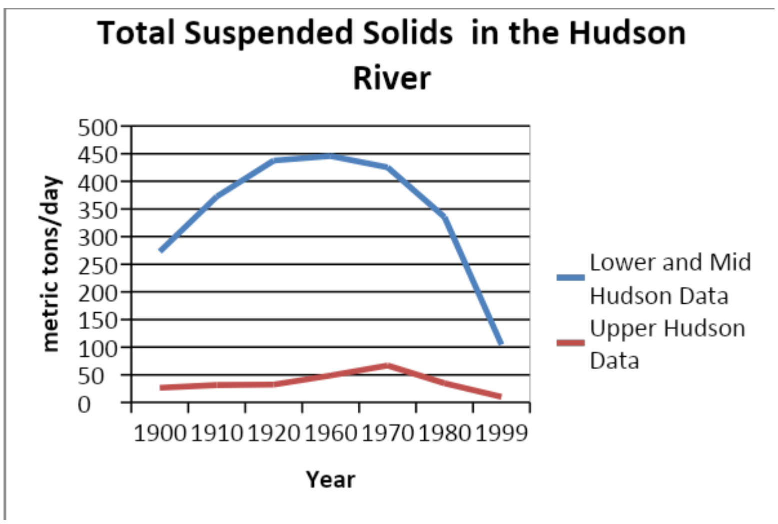


Data from Brosnan, T.M, Stoddard, A., and L.J. Hetling. 2006. Hudson River Sewage Inputs and Impacts: Past and Present in J. S. Levinton and J.R. Waldman (Eds.) The Hudson River Estuary; New York: Cambridge Press.



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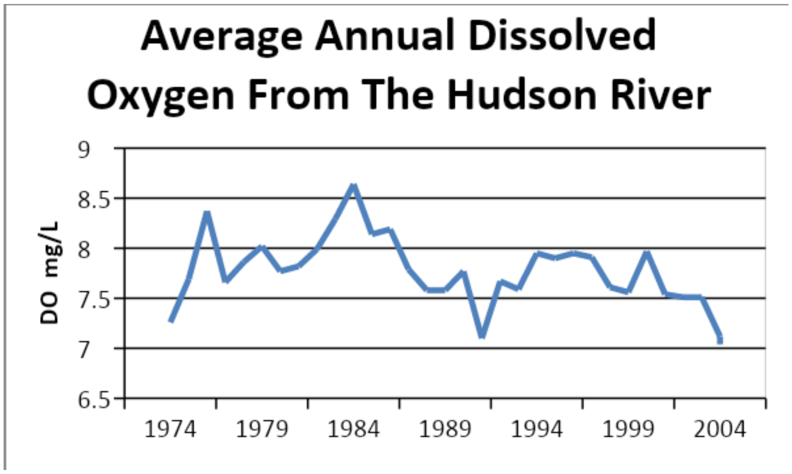
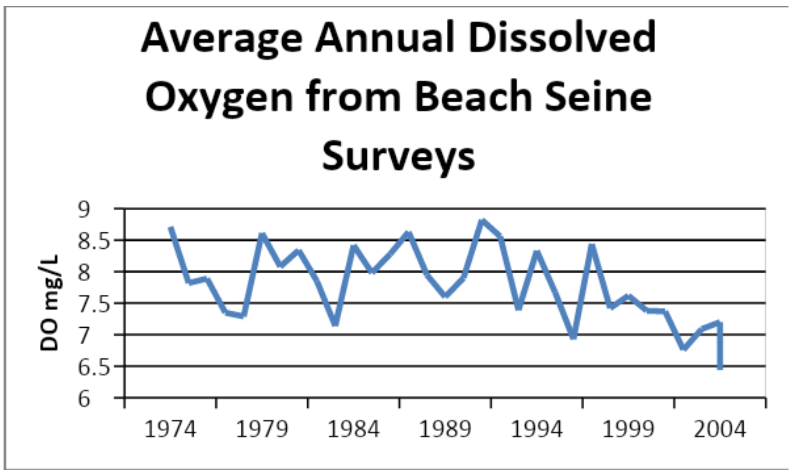
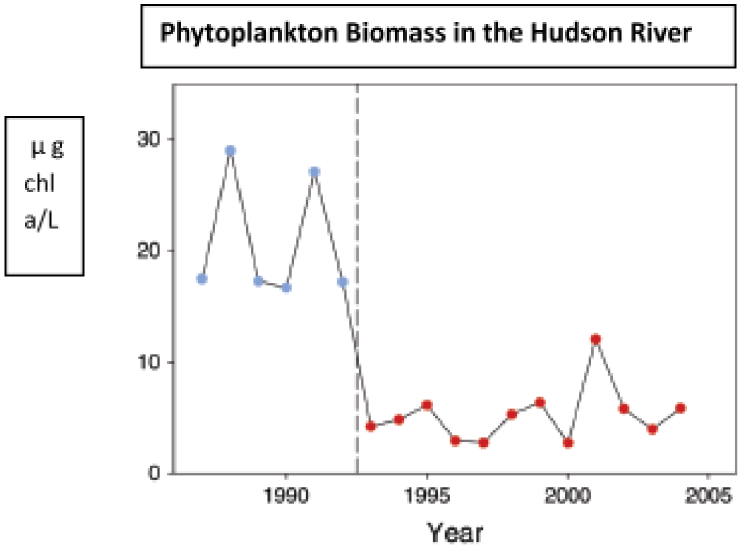
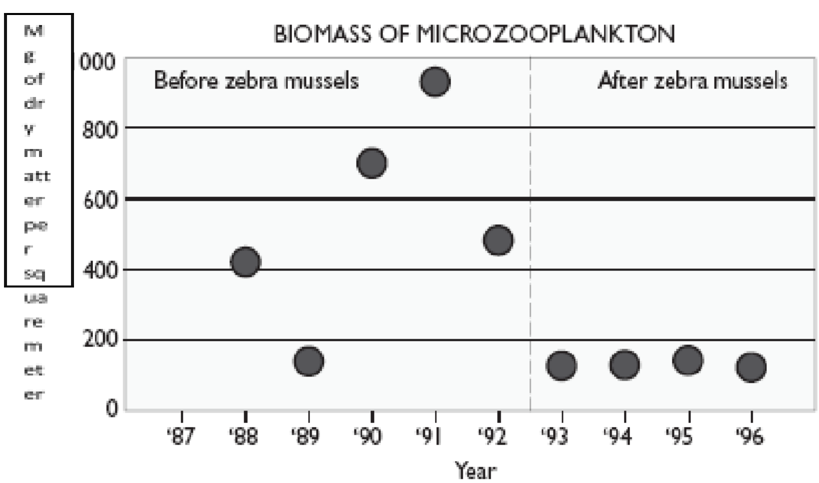




Data are annual averages from Beach Seine Survey, 2005 Year Class Report, prepared by ASA Analysis & Communication for Dynegy Roseton L.L.C.

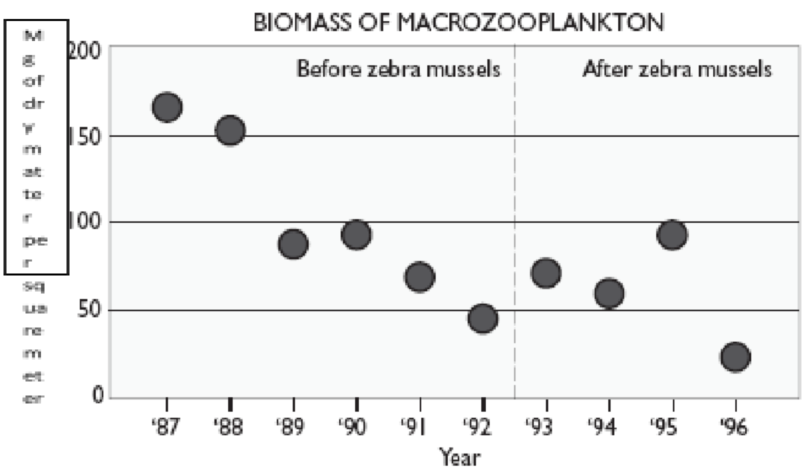


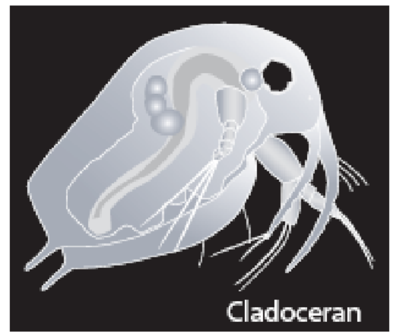
Data from: Strayer, D.L., M.L. Pace, N.F. Caraco, J.J. Cole, and S.E.G. Findlay. 2008. Hydrology and Grazing Jointly Control a Large-River Food Web. *Ecology*, 89(1), 12-18.



Strayer, D.L., N.F. Caraco, J.J. Cole, S. Findlay, and M. Pace. 1999. Transformation of

Freshwater Ecosystems by Bivalves. *BioScience*, 49: 19-27.

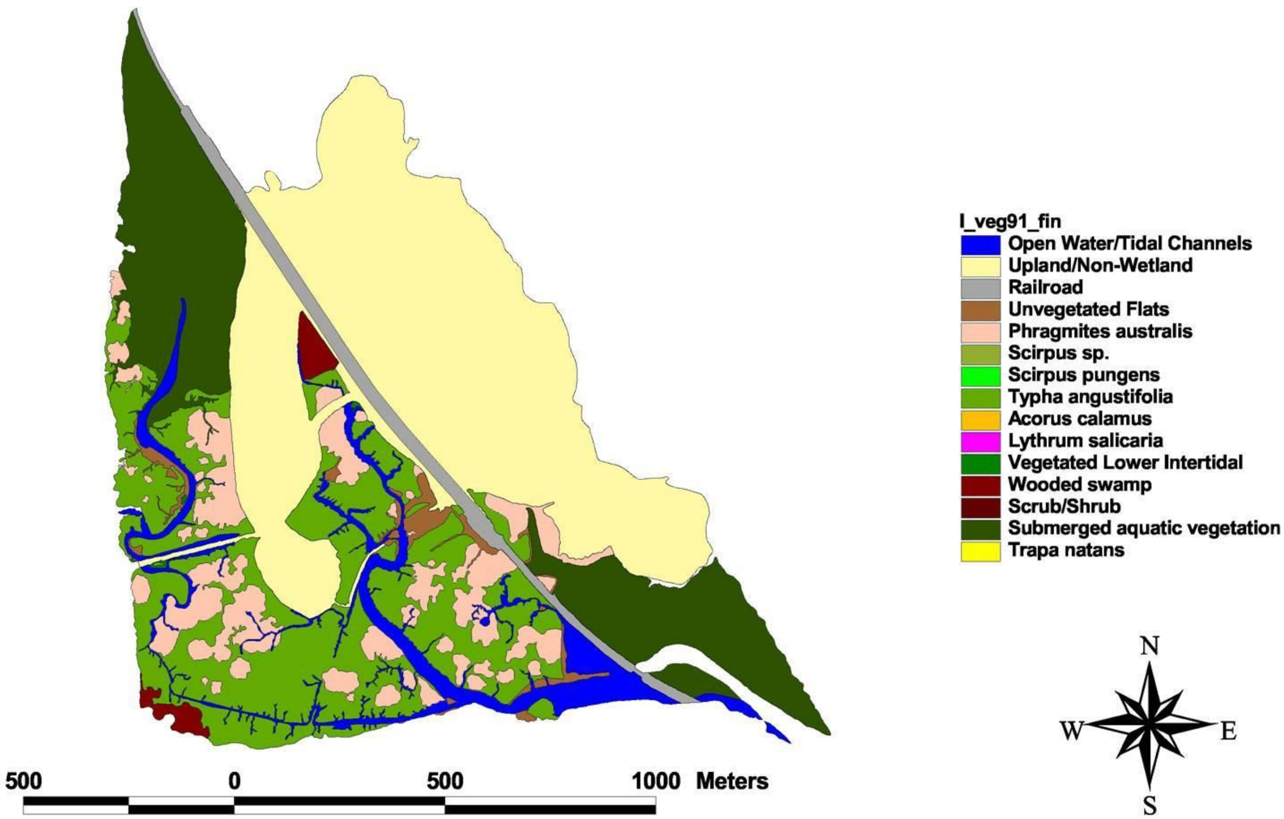




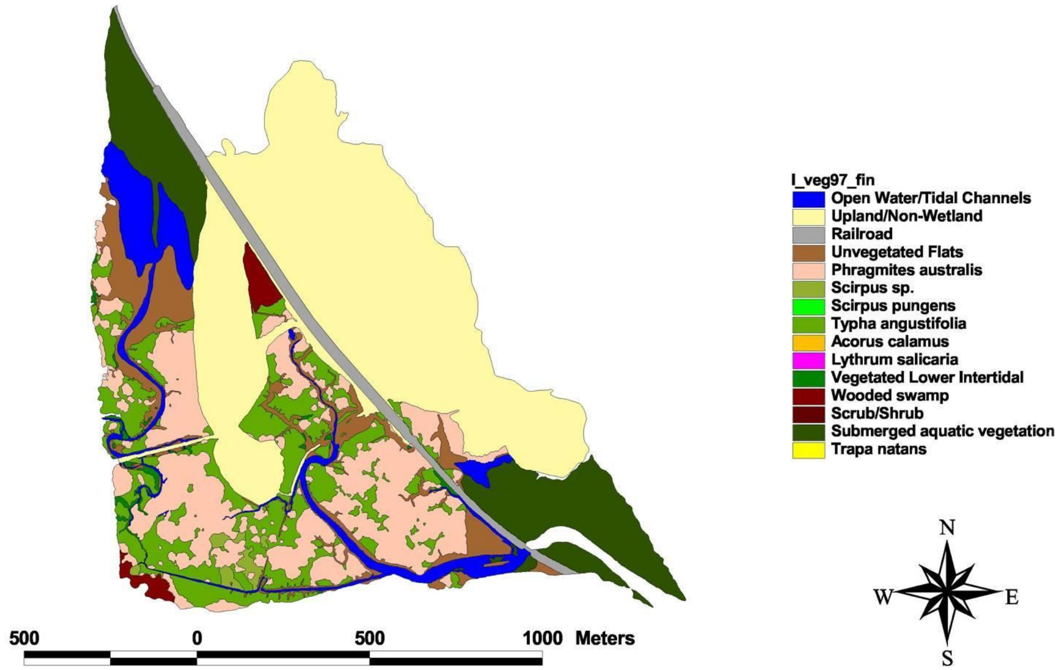
Strayer, D.L., N.F. Caraco, J.J. Cole, S. Findlay, and M. Pace. 1999. Transformation of Freshwater Ecosystems by Bivalves. *BioScience*, 49: 19-27.

Resource Packet Group 4

Iona 1991



Iona 1997



Iona 2005

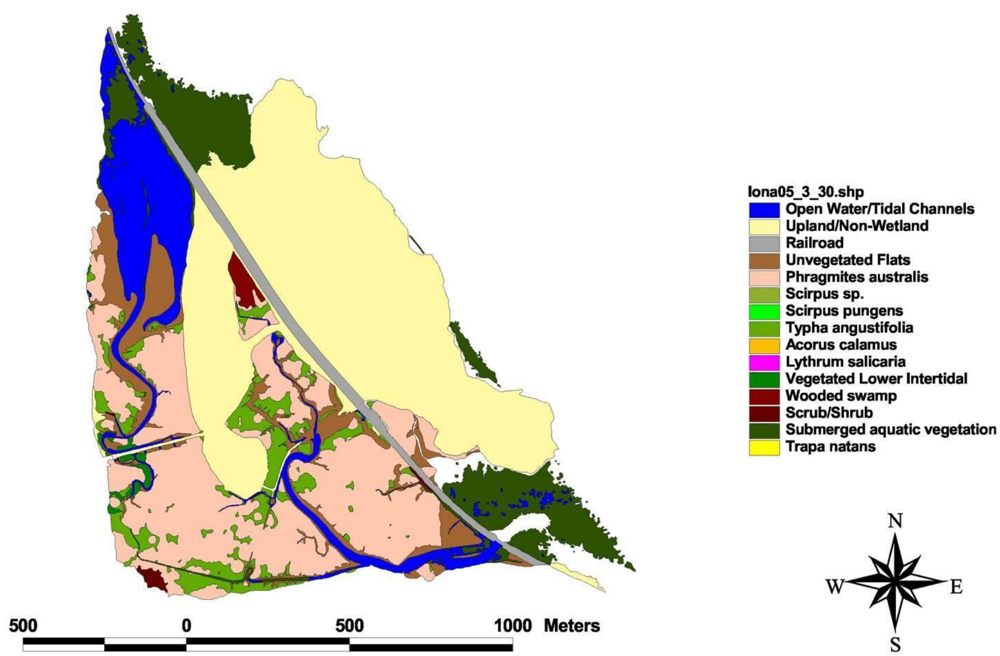


Table 3. *Diversity of marsh-dependent breeding-bird species observed at each of four marshes in the Hudson River Estuary in 2005. The average number of species, species richness, and the Shannon Diversity Index are calculated as averages per point.*

Marsh	*N* (number of sampling plot visits)	No. of Marsh-Dependent Birds	No. of Marsh-Dependent Species	Average No. of Species	Species Richness	Shannon Diversity Index
Iona	147	304	18	2.1	1.14 ± 0.07	1.51 ± 0.13
Constitution	146	770	25	5.7	2.71 ± 0.12	2.63 ± 0.07
Tivoli	133	629	15	4.7	2.79 ± 0.11	2.50 ± 0.06
Stockport	90	428	12	4.8	2.86 ± 0.15	2.65 ± 0.07

Table 8. *Density of plant stems (No. of stems m^{-2} [±1 standard deviation]) at the four Hudson River marshes in 2005.*

Plant Species	Iona	Constitution	Tivoli	Stockport
Phragmites australis	35.36 (25.15)	0	0	0
Typha angustifolia	12.29 (21.83)	34.63 (22.2)	46.73 (17.46)	21.36 (15.74)
Lythrum salicaria	0.11 (0.62)	0.32 (1.26)	2.51 (5.48)	1.53 (4.82)
Peltandra virginica	0.71 (2.45)	12.74 (14.54)	4.58 (4.24)	6.26 (6.33)
Sagittaria latifolia	0	0.39 (1.39)	0.75 (1.9)	0.42 (1.19)
Schoenoplectus fluviatilis	0.05 (0.69)	0.41 (2.6)	1.01 (6.05)	4.14 (7.16)
n	208	205	166	108

Wells, A.W., Nieder WC, Swift BL, O'Connor KA, Weiss CA. (2008) Temporal changes in the breeding bird community at four Hudson River tidal marshes. *Journal of Coastal Research*, 55:221-235.

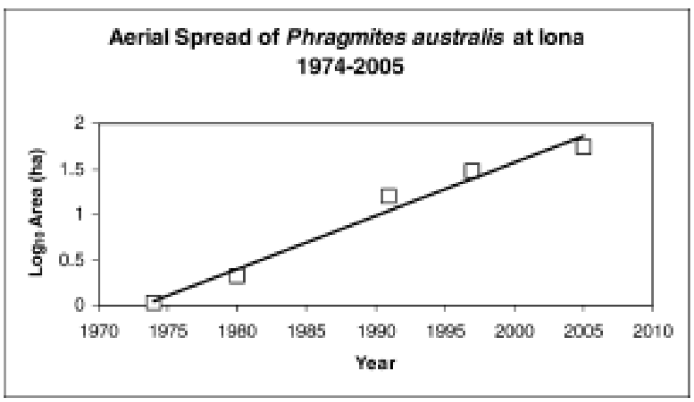
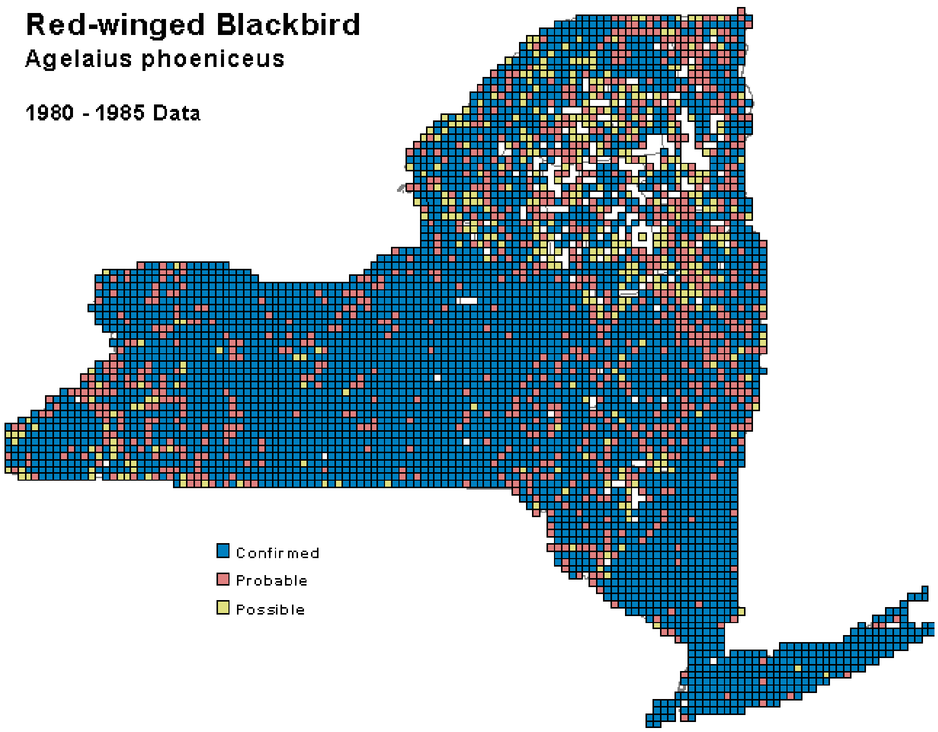


Figure 9. Aerial spread of *Phragmites australis* at Iona Island from 1974 to 2005 ($r = 0.96$, $p = 0.0015$). Data compiled from Winogrond (1997).

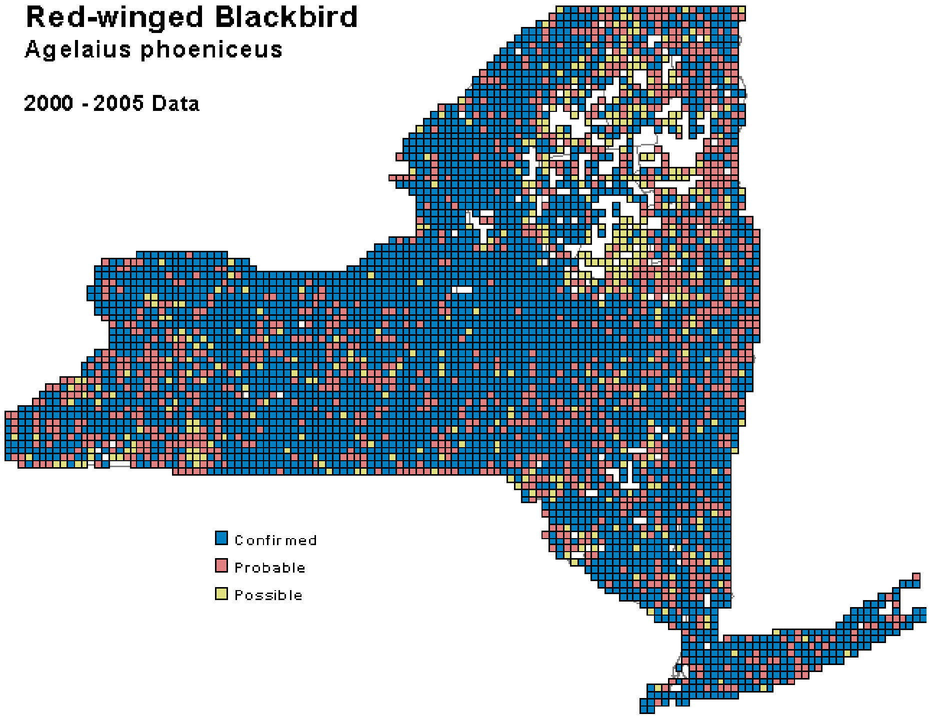
Wells, A.W., Nieder WC, Swift BL, O'Connor KA, Weiss CA. (2008) Temporal changes in the breeding bird community at four Hudson River tidal marshes. *Journal of Coastal Research*, 55:221-235.

Data From: New York State Breeding Bird Atlas



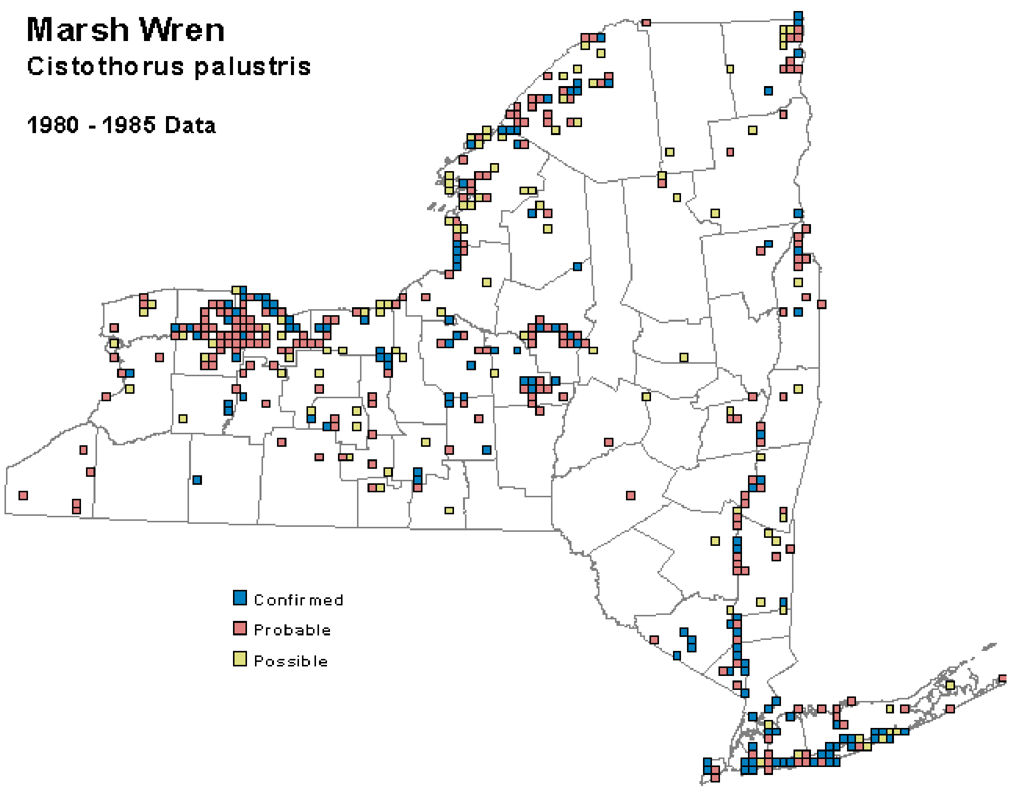
Red-winged Blackbird
Agelaius phoeniceus

2000 - 2005 Data



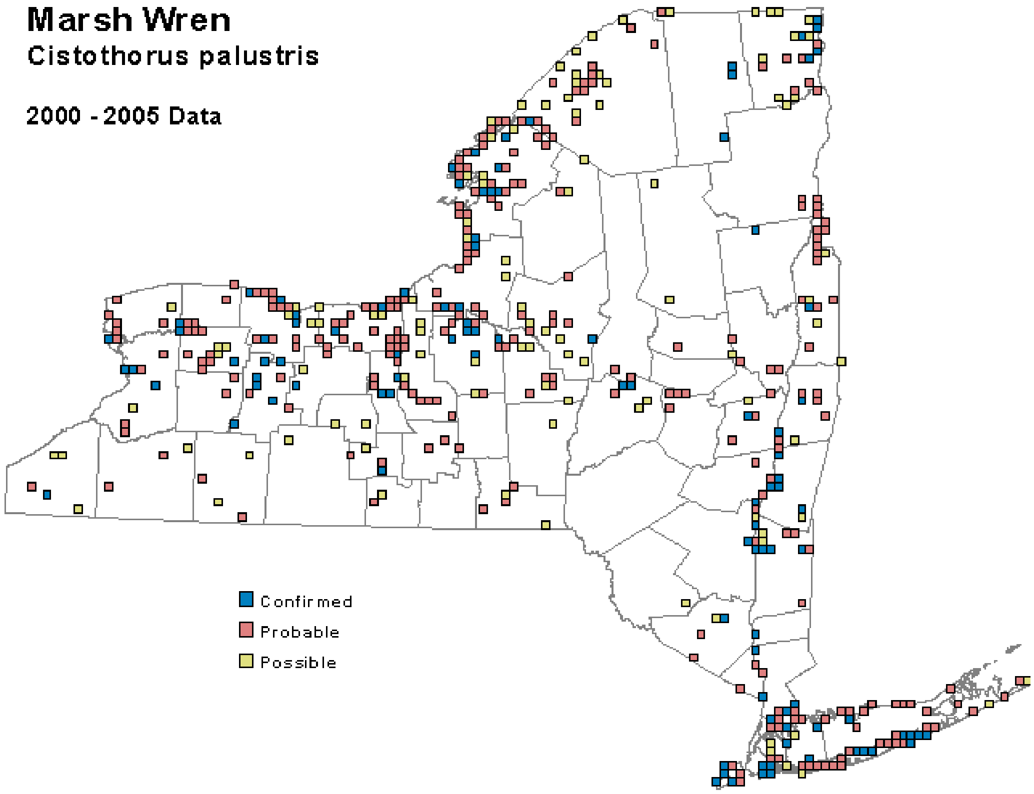
Marsh Wren
Cistothorus palustris

1980 - 1985 Data



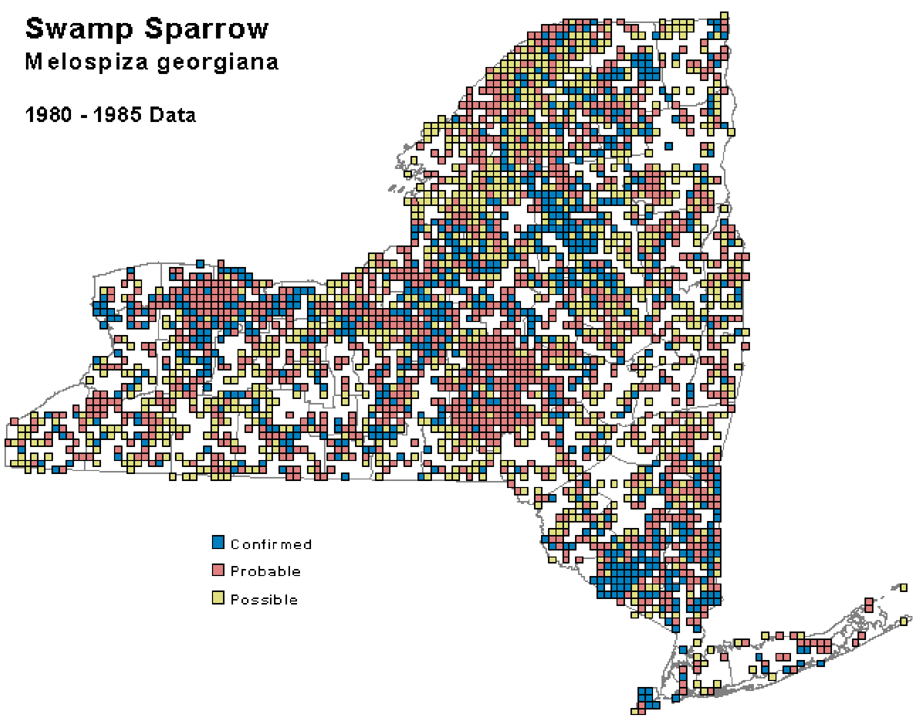
Marsh Wren
Cistothorus palustris

2000 - 2005 Data



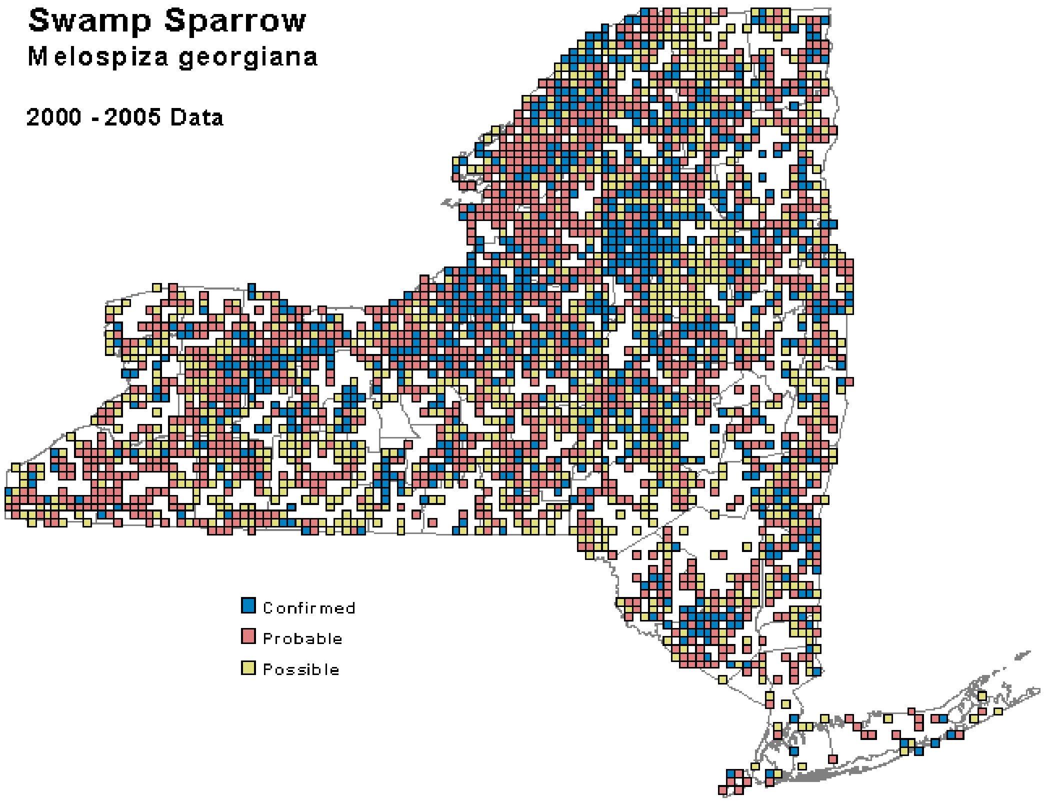
Swamp Sparrow
Melospiza georgiana

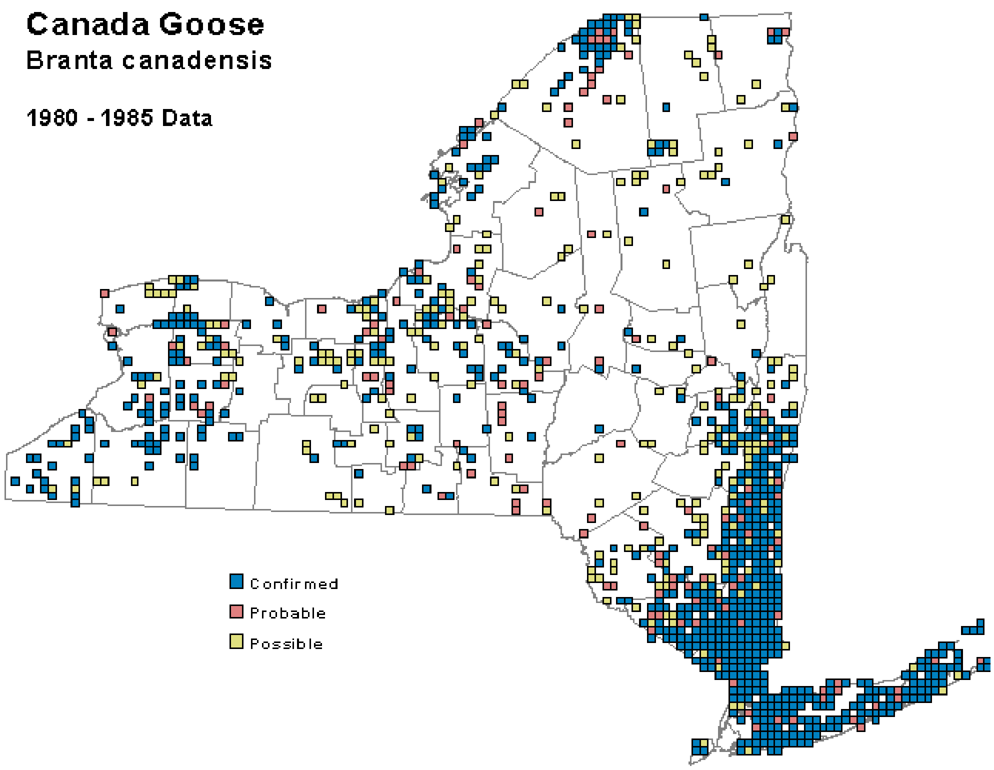
1980 - 1985 Data

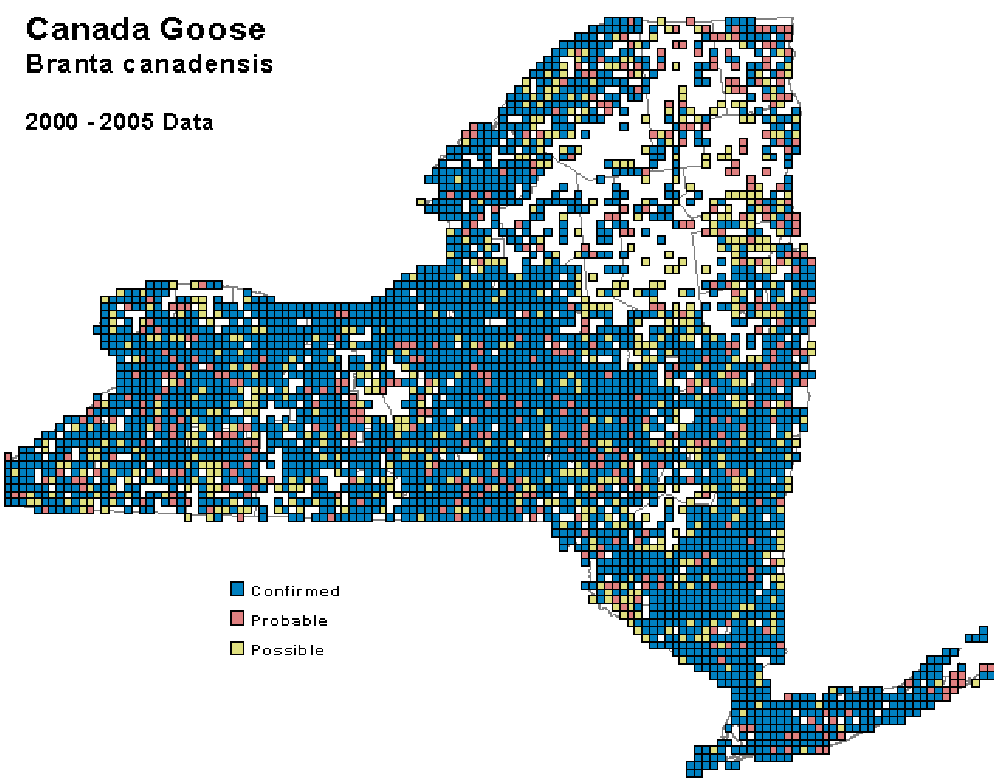


Swamp Sparrow
Melospiza georgiana

2000 - 2005 Data




Canada Goose
Branta canadensis
1980 - 1985 Data
Confirmed
Probable
Possible

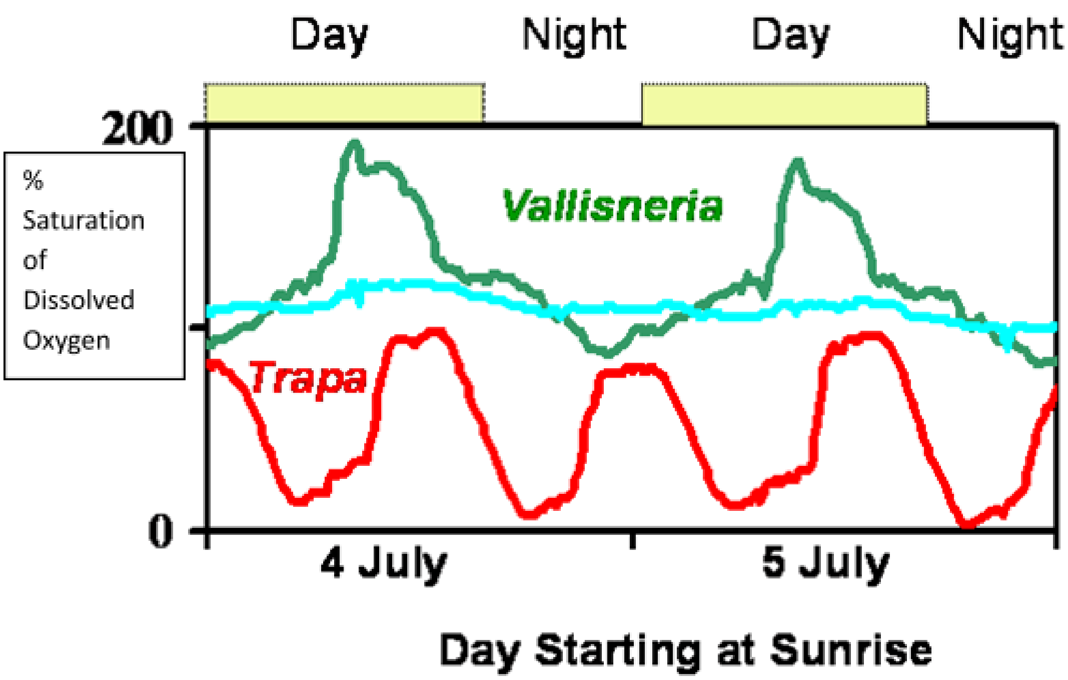

Canada Goose
Branta canadensis
2000 - 2005 Data
Confirmed
Probable
Possible

Resource Packet Group 5:

Native water celery (*Vallisneria americana*) can be seen under the water's surface; a single water chestnut plant (*Trapa natans*) is floating on top. Water chestnuts are invasive plants in the Hudson River.

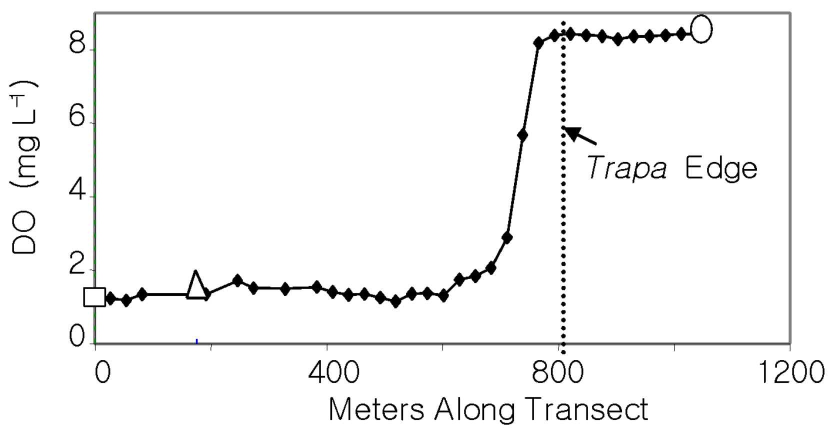
Trying to kayak through a water chestnut bed on the Hudson River.

Inbocht Bay, Hudson River. The photo on the left was taken in 1995, while the photo on the right was taken in 2002. Both photos were taken at the same time of year, in July. The light green that is spreading in the photos is the water chestnut. An island is visible in the middle.



The green line, labeled *Valisneria*, refers to water celery, which is the native, submerged aquatic plant. The red line, labeled *Trapa*, refers to water chestnut, which is the invasive, floating plant. The light blue line are samples that were taken from the middle of the channel, where there are no submerged or floating plants. Caraco, N. F., J. J. Cole, S. E. G. Findlay, and C. Wigand. 2006. Vascular plants as engineers of oxygen in aquatic systems. BioScience 56(3):219-225.

Dissolved Oxygen Measurements From the Shore to the Main Channel



Caraco, N. F., J. J. Cole, S. E. G. Findlay, and C. Wigand. 2006. Vascular plants as engineers of oxygen in aquatic systems. BioScience 56(3):219-225.