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Saturday, October 26, 2013
Bergen Community College
Paramus, New Jersey

Conference Theme
Bioethics

Keynote Address
The History and Bioethics of the Immortal Human Cell Line

will be presented by

Christoph Lengauer

Chief Scientific Officer of Blueprint Medicines

Instructions for Authors

IN VIVO is published three times yearly during the Fall, Winter, and Spring. Original research articles in the field of biology in addition to original articles of general interest to faculty and students may be submitted to the editor to be considered for publication. Manuscripts can be in the form of a) full length manuscripts, b) mini-reviews or c) short communications of particularly significant and timely information. Manuscripts will be evaluated by two reviewers.

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Keynote Speaker

Dr. Christoph Lengauer

Christoph Lengauer, Ph.D., is the chief scientific officer of Blueprint Medicines (Cambridge, MA). He joined Blueprint Medicines from Sanofi, where he was Vice President and Global Head of Oncology Drug Discovery and Preclinical Development. Before joining Sanofi in Paris, France, Dr. Lengauer was Executive Director and Senior Unit Head of Oncology Discovery at the Novartis Institutes for Biomedical Research (NIBR). Prior to Novartis, Dr. Lengauer served as Associate Professor of Oncology at the Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins University in Baltimore.

Dr. Lengauer studied human genetics in Salzburg, Austria, and obtained his Ph.D. from the University of Heidelberg, Germany. He did his postdoctoral research at the Research Institute of Molecular Pathology (IMP) in Vienna and then in the laboratory of Professors Bert Vogelstein and Ken Kinzler at the Johns Hopkins University School of Medicine, and also received a MBA from Johns Hopkins University Business School.

Dr. Lengauer discovered that all cancers are genetically unstable. He has a proven track record in cancer drug discovery, including contributing to 17 development candidates, 11 drugs/programs that reached first in human clinical trials and two registered drugs. He serves as a Member on the Scientific Advisory Board of the biopharmaceutical company, Covagen AG and as a Member of the Scientific Advisory Board of Gene Network Sciences, Inc.

Dr. Lengauer is lead or senior author of numerous scientific articles that have been published in highly esteemed journals such as Cell, Nature, and Science. In 2007, he received the Top Innovator - Novartis Oncology President's Award. He is a strong and outspoken advocate of patients' rights and is featured in the bestseller "The Immortal Life of Henrietta Lacks."

Vascular Flora of the Levy Preserve, Nassau County, New York

by

Richard Stalter
Department of Biological Sciences, St. John's University, Jamaica, NY

Abstract

The objective of the present study was to document the vascular plant species at the Levy Preserve, Nassau County, New York. Monthly trips were made to the preserve during the growing season of 2007, and twice a month during the growing seasons of 2008 to July, 2012. Vouchers were mounted on herbarium paper and deposited at the A. C. More Herbarium, University of South Carolina. The vascular flora consists of 199 species in 145 genera in 55 families. Families with the greatest number of species are the *Asteraceae* (34) *Poaceae* (27) and *Fabaceae* (16). Altogether these families compose 38% of the flora. The genus with the largest number of species was *Trifolium*, with five. One hundred one non-native taxa compose 51% of the flora.

Key words: flora, biodiversity, landfill, Levy Preserve, Nassau County, New York.

Introduction

The Levy Preserve (40°38’47” N 73° 33’46”W) extends east of the Meadow Brook Parkway, south of Merrick Road. The park is bordered by a recycling center on its northern side, extensive salt marshes on the south, a golf course and play ground on its eastern border and the Meadowbrook Parkway on the west. Construction on the preserve began in 1998 and was completed in 2000. The preserve containing 21 hectares was opened to the public in 2000. Named after Republican environmentalist Norman Levy who was instrumental in preserving green areas in Nassau County, the preserve resides on an old landfill rising 35.1 meters above the surrounding land. The landfill was capped with 0.6 to 1.5 meters of soil and seeded with a mix of wildflowers and grasses. Shrubs and tree species have also been planted at the preserve. The gardens at the visitor's center are planted with wildflowers each spring and weeded periodically during the growing season. The lawn at the visitor's center is mowed when needed. The right-of-way that borders the trails to the top of the landfill is brush hogged while the vegetation immediately bordering the paths is treated with glyphosate to prevent the vegetation from encroaching on the paths.

With the exception of the vegetation treatment and manipulations described above, the sides and crest of the landfill lie fallow. The sides of the landfill are populated with *Artemisia vulgaris*, *Alliaria petiolata*, *Galium aparine*, *Polygonum cuspidatum* and *Phragmites australis*. Invasive tree species include *Morus alba* and *Ailanthus altissima*. The top of the landfill contains two manufactured ponds approximately 0.28 and 0.40 hectares respectively in size. *Phragmites australis*

the most common pond side taxon thrives along the edge of the ponds and is accompanied by *Carex albolutescens*, *Typha latifolia* and several grasses. Two tallgrass prairie taxa, *Andropogon ge*rardii and *Sorghastrum nutans* plus additional grasses and forbs populate the top of the landfill. Two small Diamondback terrapin nesting sites were created along the path at the east and south side of the landfill. Brush piles were established at several sites on the side of the landfill as refuges for small mammals.

Plant Communities

Five naturally occurring plant communities occur at the preserve. These include an extensive- salt marsh community at the east and southern portion of the preserve, a brackish marsh community bordering the Meadowbrook Parkway, a small freshwater marsh community bordering the two man-made ponds, a successional community composed mainly of *Artemisia, Galium* and *Phragmites* that populates the sides of the landfill where human disturbance/ manipulation is minimal, and a ruderal community, on mowed roadsides, lawns, animal facilities, a small flower garden near the visitor's center, plantings on the northern side of the landfill, disturbed soil in the vicinity of the visitors center and parking lot and animal facilities.

The Salt Marsh Community

The salt marsh community is well developed on land bordering the fishing pier and at southern portions of the Levy Preserve. Soil and water salinity and tidal flooding influence the distribution of salt marsh species. Taxa observed there were *Spartina alterniflora*, *Atriplex patula*, *Aster tenuifolius*, *Iva oraria* and *Limonium carolinianum*. Shrubby *Baccharis halimifolia* grows above Iva and only experiences tidal flooding during severe nor- easters and hurricanes. *Phragmites* borders *Spartina alterniflora* and extends upward on the sides of the landfill. The preserve's *Phragmites* is an alien variety that may be more vigorous and more salt tolerant than our native variety of *P. australis*.

Brackish Marsh Community

Water salinity at the brackish marsh bordering the western boundary of the preserve, east of the Meadowbrook Parkway ranges from less than 0.1 ppt to 10 ppt. Highest salinity occurs in summer when water and air temperature is highest and evaporation is greatest. The dominant taxon is *Phragmites australis*. *Spartina alterniflora* is a minor component of this community occasionally occupying the wetland below *Phragmites*. *Aster tenuifolius* was observed at the right side of the kayak launch site mixed with *Phragmites*.

Freshwater Marash Community

The freshwater marsh community borders the two ponds at the top of the landfill. *Phragmites*, *Typha* and *Nymphaea* are the most conspicuous taxa present here. This is the smallest plant community at the preserve.

Successional Community

A successional community of grasses forbs and invading woody taxa is the largest community at the preserve. The steep sides of the landfill are mainly populated, by *Phragmites*, *Artemisia*, *Alliaria* and *Galium*. Woody invasives include *Morus alba*, *Acer spp*, *Celastrus*

orbiculatus, *Rhus spp*. and *Elaeagnus*. The top of the landfill contains a more varied assemblage of herbaceous taxa but fewer woody taxa. Notable here are *Andropogon gerardii* and *Sorghastrum nutans*, two tall grass prairie grasses. The top of the landfill may experience more human "intervention" to maintain its graminoid and forb dominance. Trees may continue to invade the sides of the landfill, providing more favorable habitat for the invasion of shade tolerant taxa.

Ruderal Community

The fifth community, the ruderal community, occupies the gravel "roadside" right-of-ways, lawns, paths and gardens. Common taxa here are *Arenaria serpyllifollia*, *Cerastium glomeratum*, *Chenopodium album*, *Linaria canadensis*, *Lepidium virginanum*, *Mollugo verticillata*, *Plantago aristata*, several graminoid taxa and *Veronica arvensis*. The alien grass, *Eragrostis curvula*, is well established on path sides and may become more abundant at the landfill in the future.

Climate

Climate at the Levy Preserve is slightly milder than sites inland. Detailed climatic data exists for Point Lookout, 6 km west of the preserve in the monthly bulletin of the National Oceanic and Atmospheric Administration[1]. July is the warmest month with the average temperature of 23ºC while January is the coldest month averages -0.4ºC. The average length of the frost free season is slightly over 200 days. Average annual rainfall is about 1140 mm and is evenly distributed throughout the year.

Methods

Collecting trips were made to the preserve approximately once every two weeks beginning May 2007 through October 2007 and twice a month from 2008 until July 2012. Objectives for each trip included the collection of voucher material and information on the abundance and site preference for each vascular plant species. Vouchers were deposited at the A.C. Moore Herbarium, University of South Carolina.

The annotated checklist contains an inventory of the vascular plants that reproduce spontaneously and persist for more than one year without cultivation, including native taxa, naturalized and adventive weeds, and escapes from cultivation. In the checklist plants are arranged first by division, and then alphabetically by family and by species. Each entry includes the following information sequence: scientific name; pertinent synonym enclosed in brackets; frequency relative to the study area, using the categories: rare (scarce, less than 5 populations), infrequent (uncommon, occasional, 5 to 20 populations), frequent (common, more than 20 populations). Estimates of species frequency are based upon my personal observation.

Indication of species rarity across all of New York State is based upon the New York Natural Heritage Program[2].

Nomenclature primarily follows Gleason and Cronquist[3], but recent taxonomic revisions in Kartesz[4] were consulted to update the nomenclature in this flora. When the currently accepted name is different, the name as presented in Gleason and Cronquist immediately follows, enclosed in brackets. In most cases nomenclature presented in this flora agrees with Kartesz, but when differences occur, the name as presented

in Kartesz is listed as a synonym and enclosed in brackets.

Results and Discussion

The vascular flora of the Levy Preserve is composed of 199 species in 145 genera within 55 families. The largest families in the flora were the *Asteraceae* (34 species) and *Poaceae* (27 species). The *Fabaceae* with 16 species ranks third. The largest genus was *Trifolium* with 5 species while *Acer* and *Polygonum*, had 4. The percentage of non-native vascular plant species, 51%, was significantly higher than New York states' non-native plant species, 35%. No rare taxa occur here.

Because information on introduced taxa is sketchy, taxa known to be planted are not included in the appendix. Herbaceous planted taxa observed in July, 2007 were: *Asclepias tuberosa*, *A. purpurascens*, *Buddleja davidii*, *Gailardia puchella*, *Ratibida pinnata*, *Eupatorium coelestinum*, *Equisetum arvense*, *Lythrum salicaria* and *Papaver rhoeas*. *Lythrum salicaria* has become naturalized and was observed with *Phragmites* bordering the walk way behind the visitors center in 2012.

Several alien taxa pose a threat to native vascular plants. *Celastrus orbiculatus* was observed on the sides of the landfill and may grow up and over native species, covering and smothering them. *Phragmites australis* was well established on the sides of the landfill, pond sides and also along the man-made waterway that borders the Meadowbrook Parkway. University of Maryland scientists have identified five non-native varieties of *Phragmites*; these are more aggressive than the single native North American variety.

Elaeagnus spp., Russian Olive, occurred at scattered sites on the landfill. Selective cutting followed by the application of glyphosate to cut stems should kill *Elaeagnus*. *Lythrum salicaria* was present in small numbers at the flower gardens at the visitors' center and has spread to the boardwalk behind the visitor center.

Species of foreign origin were numerous in the flora, were a major component of the natural vegetation and occur throughout the preserve. Doubtless, exotic species will continue to invade and become established at Levy Preserve as the human visitation increases scattering seeds, while maintenance may create new open habitats of disturbance favorable to their establishment.

Acknowledgments

Appreciation is expressed for unrestricted access to the Levy Preserve. Appreciation is also expressed to Eric Lamont for identifying some Asteraceae, John Nelson who assisted with the Poaceae, and Gordon Tucker with the Cyperaceae. Appreciation is also expressed to: Kate Murray, Nassau County Supervisor, Louis DiGrazia, Commissioner of Sanitation, Michael J. McConnell, Deputy Commissioner of Sanitation and Norman J. Levy Park and Preserve, Richard Ronan, Commissioner of Sanitation, Susan Nurmi, Chief Ranger of Conservation for Norman J. Levy Park and Preserve, Tina Ryan, Chief ranger of Administration for Norman J. Levy Park and Preserve, Phil Gold, Assistant Chief Ranger of Administration for Norman J. Levy Park and Preserve , and Scott Oglesby, Bird Enthusiast and Chief Ranger of Education for Norman J. Levy Park and Preserve. Dr. Dwight Kincaid reviewed the paper. Finally, I acknowledge the assistance of Joseph Renda, undergraduate research assistant at St. John's University, and the financial support of St. John's University.

Table 1. A summary of the vascular plant species at the Levy Preserve					
	Spore Plants	**Conifers**	**Dicots**	**Monocots**	**Total**
Families	0	1	46	8	55
Genera	0	1	113	31	145
Species	0	1	157	41	199
Native Species	0	1	75	22	98
Non-Native Species	0	0	82	19	101

References

[1]Garwood, A.N., 1996. *Weather America.* Toucan Valley Publication, Inc. Milpitas, CA. 1412 pp.

[2]Young, S.M., 2010. New York Plant Status Lists June 2010. New York National Heritage Program. Albany, New York. 97 pp.

[3]Gleason, H.A. and A. Cronquist, 1991. *Manual of vascular plants of northeastern United States and adjacent Canada*. 2nd ed. The New York Botanical Garden, Bronx.

[4]Kartesz, J.T., 1994. *A synonymized checklist of the vascular flora of the United States, Canada, and Greenland*. 2nd ed. Volume 1 - Checklist. Timber Press, Inc. Portland, OR. 622 p.

[5]Cronquist, A., 1988. *The evolution and classification of flowering plants*. 2nd ed. The New York Botanical Garden, Bronx. 555 p.

ANNOTATED CHECKLIST OF SPECIES

The vascular plant taxa have been arranged according to the following categories: vascular cryptogams, gymnosperms, dicots, and monocots. Within each category, families and lower taxa are arranged alphabetically. The concept of families follows Cronquist[5]. Nomenclature primarily follows Gleason and Cronquist[3], but recent taxonomic revisions and Kartesz[4] were consulted to update the nomenclature. Each entry includes the following information sequence: scientific name; pertinent synonym, enclosed in brackets; frequency relative to the study area, using the categories: rare (scarce, less than 5 populations), infrequent (uncommon, occasional, 5 to 20 populations), frequent (common, more than 20 populations). An asterisk indicates a non-native taxon[3].

PINOPHYTA

Cupressaceae

Juniperus virginiana L. rare.

MAGNOLIOPHYTA - MAGNOLIOPSIDA

Acerceae

**Acer negundo* L. infreq.

**Acer plantinoides* L. infreq.

Acer rubrum L. infreq.

Acer saccharinum L. infreq.

Amaranthaceae

**Amaranthus hybridus* L. freq.

**Amaranthus retroflexus* L. freq.

Anacardiaceae

Rhus copallinum L. infreq.

Rhus glabra L. infreq.

Rhus hirta (L.) Sudworth [R. typhina L.] infreq.

Toxicodendron radicans (L.) Kuntze [*Rhus radicans L.]* infreq.

Apiaceae
**Daucus carota* L. infreq.
**Pastinaca sativa* L. rare.
Zizia aurea L. rare.

Apocynaceae
Apocynum cannabinum L. infreq.

Aquifoliaceae
Ilex opaca Ait. rare.

Asclepiadaceae
Asclepias incarnata L. var. pulchra (Ehrh.) Pers. rare.
Ascelpias syriaca L. infreq.

Asteraceae
**Achillea millefolium* L. subsp. lanulosa (Nutt.) Piper. freq.
Ambrosia artemisiifolia L. freq.
**Arctium minus* (Hill) Bernh. rare.
**Artemisia annua* L. infreq.
**Artemisia vulgaris* L. infreq.
Aster dumosus L. freq.
Aster pilosus var. demotus Blake [*Aster racemosus* Ell.]. infreq.
Aster tenuifolius L. Kayak launch area. rare.
Baccharis halimifolia L. freq.
Bidens frondosa L. rare.
**Centaurea biebersteinii* [*C. maculosa* auct. non Lam.] freq.
**Cichorium intybus* L. infreq
**Chrysanthemum leucanthemum* L. freq.
Conyza canadensis L. Cronq. var. pusilla (Nutt.) Cronq. [Eri*geron canadensis* L. var. pusilla (Nutt.) Boivin, non Ahles]. freq.
Coreopsis lanceolata L. freq.
Erigeron strigosus L. Muhl. ex Willd. *infreq.*
Eupatorium hyssopifolium L. freq.
Euthamia graminifolia L. Nutt. [Solidago *graminifolia* L. Salisbury]. freq.
Euthamia tenuifolia (Pursh)Greene. infreq.
Gaillardia pulchella Foug. freq.
**Galinsoga quadriradicata* Ruiz & Pav. infreq.
Gnaphalium obtusifolium L. freq.
**Hieracium caespitosum* Dumort. freq.
**Hypochoeris radicata* L. freq.
Iva frutescens L. freq.
Krigia virginica L. freq.
**Lactuca serriola* L. freq.
Pluchea camphorata (L.) DC. infreq.
Rudbeckia hirta L. freq.
**Senecio vulgaris* L. freq.
Solidago sempervirens L. var. mexicana L. Fern. freq.
**Sonchus oleraceus* L. infreq.
**Taraxacum officinale* Weber. freq.
**Xanthium* strumarium L. var. canadense (Miller) T. & G. infreq.

Brassicaceae
**Alliaria petiolata* (M. Bieb.) Cavara & Grande. freq.
**Arabidopsis thaliana* L. Heynh. freq.
**Barbarea vulgaris* (L.) R. Br. infreq.
**Capsella bursa-pastoris* L. Medikus. infreq.
Cardamine parviflora L. var. arenicola (Britton) O. E. Schulz. infreq.
Draba verna L. freq.
**Lepidium campestre* (L.) R. Br. freq.
Lepidium virginicum L. freq.
**Raphanus raphanistrum* L. infreq.

Campanulaceae
Triodanis perfoliata L. Nieuwl. [Specularia perfoliata L. A. DC.]. freq.

Caprifoliaceae
**Lonicera japonica* Thunb. freq.
**Lonicera morowii* A. Gray. infreq.
Sambucus canadensis L. infreq.

Caryophyllaceae
**Arenaria serpyllifolia* L. freq.

Cerastium glomeratum Thuillier [C. viscosum L.]. infreq.
Dianthus armeria L. freq.
Lychnis alba L. freq.
Silene dichotoma Ehrh. freq.
Silene latifolia Poir. freq.
Spergularia marina L. Griseb. [*S. salina* J. & K. Presl]. infreq.
Stellaria media L. Villars. freq.

Celastraceae
Celastrus orbiculatus Thunb. freq.

Chenopodiaceae
Atriplex patula L. infreq.
Chenopodium album L. freq.
Chenopodium ambrosioides L. freq.
Suaeda linearis (Elliot) Moq. infreq.

Cistaceae
Lechea mucronata Raf. [L. villosa Ell.]. infreq.

Clusiaceae (formerly Hypericaceae)
Hypericum gentianoides L. B.S.P. locally freq.
Hypericum prolificum L. infreq.
Hypericum punctatum Lam. freq.

Convolvulaceae
Calystegia sepium L. R. Br. [Convolvulus sepium L.]. infreq.
Convolvulus arvensis L. freq.

Elaegnaceae
Elaeagnus angustifolia L. infreq.

Euphorbiaceae
Chamaesyce maculata L. Small [*Euphorbia maculata* L., E. supina Raf.]. freq.

Fabaceae
Apios americana Medik. infreq.
Coronaria varia L. freq.
Gleditsia triacanthos L. infreq.
Lathyrus latifolius L. infreq.
L*espedeza capitata* Michx. infreq.
Lotus corniculatus L. freq.
Melilotus alba Medik. freq.
*Melilotus officionalis (L.) Lam. freq
Robinia pseudoacacia L. infreq.
Strophostyles helvola (L.) Ell. infreq.
Trifolium arvense L. freq
Trifolium campestre Schreb. freq.
Trifolium hybridum L. freq.
Trifolium pratense L. freq.
Trifolium repens L*. freq.*
Vicia sativa L. subsp. nigra L. Ehrh. [V. *sativa* var. angustifolia L. Ser., V. *angustifolia* L.]. freq.

Geraniaceae
Geranium carolinianum L. infreq.

Lamiaceae
Lamium amplexicaule L. infreq.
Lamium purpureum L. infreq.

Malvaceae
Althea officinalis L. established from planted material. infreq.
Abutalon theophrasti Medik. infreq.

Mimosaceae
Albizia julibrissin Durazz; rare.

Molluginaceae
Mollugo verticillata L. infreq.

Moraceae
Morus alba L. infreq.

Myricacea
Myrica pennsylvanica Mirbel. infreq.

Nymphaeceae
Nymphaea odorata L. abundant in ponds

Oleaceae
Ligustrum sinense Lour. infreq.

Onagraceae
Epilobium coloratum Biehler. infreq.
Oenothera biennis L. infreq.

Oxalidaceae
Oxalis stricta L. freq.

Phytolaccaceae
Phytolacca americana L. freq.

Plantaginaceae
**Plantago aristata* Michx. freq.
**Plantago lanceolata* L. freq.
Plantago rugelii Decne. rare.

Plumbiginaceae
Limonium carolinianum (Walt.) Britt. rare.

Polygonaceae
*Polygonum aviculare L. freq.
**Polygonum cuspidatum* Sieb. & Zucc. freq.
Polygonum pensylvanicum L. freq.
Polygonum scandens L. infreq.
Rumex acetosella L. freq.
Rumex crispus L. freq.

Portulacaceae
**Portulaca oleracea* L. infreq.

Primulaceae
**Anagallis arvensis* L. freq.

Rosaceae
Amelanchier canadensis L. Medikus. infreq.
Potentilla canadensis L. freq.
**Potentilla recta* L.
Potentilla simplex Michx. freq.
**Prunus persicaria* (L.) Batsch.
Prunus serotina Ehrh. freq.

Rubiaceae
Galium aparine L. freq.

Salicaceae
*Populus grandidentata Michx.
Populus heterophylla L. infreq.
**Salix babylonica* L. rare.

Scrophulariaceae
Linaria canadensis L. Dumort. [*Nuttallanthus canadensis* L. D. A. Sutton]. freq.
**Linaria vulgaris* Hill. freq.
**Verbascum blattaria* L. infreq.
**Verbascum thapsus* L. infreq.
**Veronica arvensis* L. freq.
**Veronica officinalis* L. rare.
**Veronica peregrina* L. infreq.
**Veronica sepyllifolia* L. infreq.

Simaroubaceae
**Ailanthus altissima* (Mill.) Swingle. infreq.

Solanaceae
Solanum carolinense L. infreq.
**Solanum dulcamara* L. freq.
**Solanum nigrum* L. infreq.

Ulmaceae
Celtis laevigata Wild. infreq.

Verbenaceae
Verbena urticifolia L. infreq.

Vitaceae
**Ampelopsis brevipedunculata* (Maxim.) Trautv. rare.
Parthenocissus quinquefolia L. Planchon. freq.

MAGNOLIOPHYTA – LILIOPSIDA

Agavaceae
Yucca filamentosa L. infreq.

Commelinaceae
Commelina communis L. rare.
Tradescantia ohiensis Raf. rare.

Cyperaceae
Carex albolutescens T. & H *Carex atlantica* Bailey. infreq.
Cyperus esculentus L. var. *leptostachya* Boeck. infreq. *Cyperus strigosus* L. freq.
Scirpus pungens Vahl [*Schoenoplectus pungens* (Vahl) Palla} infreq.

Iridaceae
Sisyrinchium angustifolium P. Mill. infreq.

Juncaceae
Juncus bufonius L. freq.
Juncus gerardii L. freq.
Juncus tenuis Willd. var. tenuis. freq.

Lilaceae
**Allium vineale* L. infreq.
Poaceae
**Andropogon gerardii* Vitman planted
**Bouteloua curtipendula* (Michx.) Torr. planted
**Bromus hordeaceus* L. infreq.
**Bromus japonicus* Thunb. ex Murr. infreq.
**Chloris verticillata* Nutt. freq.
**Cynodon dactylon* L. Pers. freq.
**Dactylus glomerata* L. infreq.
**Digitaria sanguinalis* L. Scop. freq.
Distichlis spicata L. Greene. rare.
**Echinochloa crus-galli* L. P. Beauv. infreq.
**Eleusine indica* L. Geartn. freq.
**Eragrostis curvula* (Schrader) Nees
**Festaca rubra* L. infreq.
**Lolium perenne* L. freq.
Panicum capillare L. infreq.
Panicum dichotomiflorum Michx. freq.
Panicum virgatum L. infreq.
**Phragmites australis* (Cav.) Trin. [*P. communis* Trin.]. freq.
**Poa annua* L. Lawns, roadsides and disturbed sands; freq.
Schizachyrium scoparium Michx. Nash var. *littorale* (Nash) Gould [*Andropogon scoparius* Michx. var. *littoralis* (Nash) *A. Hitchc*.]. freq.
**Setaria faberii* Herrm. freq.
**Setaria viridis* (L.) Beauv. freq.
Sorghastrum nutans (L.) Nash . infreq.
Spartina alterniflora Loisel. freq.
Spartina patens Aiton Muhl. rare.
Tridens flavus L. A.S Hitchc. freq.
**Vulpia myuros* L. C. Gmelin. [*Festuca myuros* L.]. rare.

Typhaceae
Typha angustifolia L. infreq.
Typha latifolia L. freq.

Partnerships Among Educational Seining Programs and Researchers

by

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Abstract

St. Francis College (SFC) has partnered with the Brooklyn Bridge Park Conservancy (BBPC) on the East River and the Beczak Environmental Education Center (BEEC) on the Hudson River in an effort to conduct a biomonitoring program while teaching K-college students about aquatic biodiversity through seining. The impetus of the research is to study and record seasonal and spatial differences in fish and macroinvertebrate biodiversity in these two locations that are approximately twenty miles apart. By assisting with "Catch of the Day" data collection and examining previously gathered collection data, all students have compiled species lists, and recorded relative abundance and SFC college students have computed species richness, and the Shannon-Weiner species diversity index for the two rivers. The species diversity of the Hudson River was determined to be 2.06 (92 hours of sampling effort) in 2010 and 2.26 (21 hours of sampling effort) in the East River in 2011. We have formed collaborations among St. Francis College and the two educational seining programs in an attempt to create more robust ways to sample the rivers and analyze data in conjunction with enhancing ecology education at all levels.

Introduction

Seining provides a look at "what lies beneath" to urban students that is unimaginable otherwise. The author, Kathleen Nolan, has personally seined with over 800 high school and college students since 2000, and can testify that virtually all were surprised and excited by what they saw[1]. Most of the students did not think that anything could live in waters near New York City and could not name a single fish species. Most also were afraid of the water but usually were won over after the first seine. They would then participate enthusiastically in this venture. This student-interest lead to development of a teacher-training program on integrating seining into an aquatic-based curriculum for teachers-in-training[2]. When teaching ecology at St. Francis College, Kathleen Nolan decided to incorporate seining at the Salt Marsh Nature Center in Marine Park, Brooklyn, New York into the curriculum. This carried over into the St. Francis College Summer Science Academy for High School students, in which seining has

been incorporated as an activity since 2000. With the opening of the Brooklyn Bridge Park and the Seining the River Wild program on the East River in March of 2010, (funded and administered by the Brooklyn Bridge Park Conservancy or BBPC) a closer (in proximity to St. Francis College) alternative venue has been added. Kathleen Nolan has also brought high school and college students to the Beczak Environmental Education Center (BEEC) located on the Hudson River in Yonkers. This organization also has seining programs for children. Both programs have hosted these programs for thousands of youngsters. Kathleen Nolan noted that BEEC recorded their seining data on "Catch of the Day" sheets and that this data was given to the New York Department of Environmental Conservation (NYSDEC) at the end of each year. Initially, the Brooklyn Bridge Park Conservancy program only recorded presence and absence data of fish and macroinvertebrate species. Kathleen Nolan facilitated the meeting of two of the educational directors, Kara Gilmour and Vicky Gurufi, and now the BBPC program also utilizes the "Catch of the Day" program, in which abundance and effort data are recorded in addition to presence/ absence data.

These two environmental education centers on the Hudson and East Rivers provide programming in which people from ages five through adult don waders and help drag in a seine net. The number of each species per tow is tallied on a data sheet listing all species commonly seen in the rivers. Mortality was recorded in the Hudson River whereas it was not in the East River. Overall, from personal experience, the mortality is low.

The use of students to assist in data acquisition is not new. But what can happen when teachers try to engage a group of students in an activity, valuable scientific data could be recorded but most often is not. There is an over-emphasis on the "wow" of the moment, and often in the excitement data is not recorded. Cornell University has recognized that "citizen scientists" could actually help scientists acquire data and thus make a real contribution to science[3]. These authors suggest that each project should have a goal, and it could be general, such as a temporal and spatial distribution of species or more specific. Examples include, "What are the patterns of irruption in winter finch populations?", (Project FeederWatch) and "How do clutch sizes of eastern bluebirds, *Sialia sialis,* vary with latitude?", (Project NestWatch). Shirk *et al.*[4] use the term "public participation in scientific research", (PPSR) and suggest ways to engage the public in meaningful research. They note that the degree and quality of participation is important, and propose that the project outcomes be aligned with the project design. They state that the needs and interests of all the partners should be addressed.

There are several educational seining programs within the New York/New Jersey Harbor Estuary such as those hosted by the New York City Salt Marsh Nature Center, Liberty State Park in New Jersey, Orchard Beach in the Bronx, New York and by the Clearwater organization. http:// www.clearwater.org/discovery.html). Researchers in Washington State have utilized public participation in seining program to help them acquire high-quality research data that resulted in publication[5]. To our knowledge, no one has systematically used seining data to study and publish trends and patterns of fish distribution in the New York Metropolitan area.

The goals of our pilot project were to:

1. Acquire high-quality research data through the use of students as facilitated by two environmental education centers in two urban locations of the Hudson River Estuary This data includes: seasonal and spatial (East River and Hudson River-Yonkers) distributions of fish and macroinvertebrate species, relative abundance of these species, a calculation of species diversity based on relative abundance or proportion of species, and the catch per unit effort of these species.
2. Enhance environmental/ecological education and foster engagement and stewardship of the environment by these same students.
3. Foster and strengthen partnerships among the two environmental education center, research faculty, and students, and
4. Use the results of this project to help us plan and strengthen future project design.

Fig. 1. Hudson River seining site at the Beczak Environmental Education Center in Yonkers, NY. http://www.yellowpages.com/yonkers-ny/mip/beczak-environmental-education-14418752

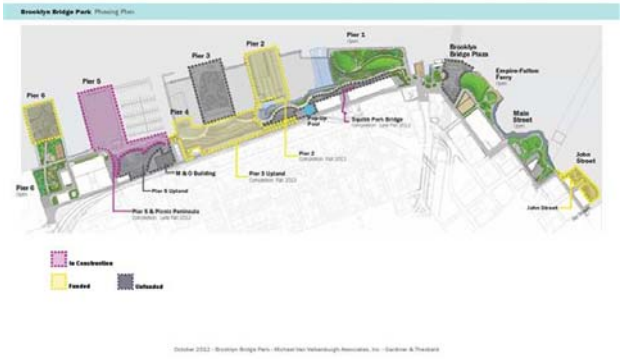

Fig. 2. East River seining site at Brooklyn Bridge Park (between Main St. and John St. directly under the Manhattan Bridge). http://www.brooklynbridgepark.org/progress/park-phasing

Materials and Methods

Nine-meter (30-ft) seine nets (BBPC) and 20 ft seinenets (BEEC) (30 mm mesh size) with waders were used to make several tows in shallow water at low tide either just off the beach under the Manhattan Bridge in the East River (GPS: 40.704324,-73.989798) or in the Hudson River (Yonkers) (GPS: 40.938199,-73.901843, Figs. 1,2.). Both BEEC and BBPC are authorized by the New York State Department of Conservation to conduct catch and release programs.

Fish and macroinvertebrates were placed in plastic 5-gallon buckets. Fish and invertebrate identification books[6-8] were used for species identification. There were approximately ten seines conducted per 90 minutes each for approximately six minutes each. Thus each catch represents a relative abundance that would represent a catch/unit effort of one hour. "Catch of the Day" data (abundance of each species) was collected from the Beczak Environmental Education Center (2010), and from summer 2010-2011 Brooklyn

Bridge Park Conservancy, seining programs. Initially, BBPC kept only presence/absence data, but switched to the abundance model in 2011. Comparisons of seasonal patterns were made, and rank abundance was determined of the top ten species. Species richness (number of species) was determined, as well as the Shannon-Weiner Species diversity index, which is: where s is the number of species.

Results

Ninety-two seining programs (92 hours of effort) at BEEC Hudson River (Yonkers, NY) were analyzed from April through October (Table 1), in which species richness and the Shannon-Weiner Biodiversity index were calculated. Presence/absence of species data were gathered from the Brooklyn Bridge Park Conservancy program (East River) in 2010. On three dates abundance data were also collected with the help of St. Francis College students and species richness and the Shannon-Weiner Biodiversity index was calculated for this small data set. When the BBPC switched to the Catch of the Day program in 2011, we were then able to obtain the data set in Table 2, which is a record of the results of 21 seining trips. Each date represents approximately one hour of unit effort of fishing with up to ten seines.

Species richness was 26 in the Hudson River and 15 initially in the East River in 2010. However, species richness increased to 30, with additional sampling effort, in the East River after the Catch of the Day program was implemented by the BBPC in 2011 ((Tables 1, 2). The Shannon-Weiner Diversity (SWD) Index increased from 1.38 to 2.26 in 2011 for the East River after implementation of the Catch of the Day Program by the BBPC, which is very similar to the two SWD indices calculated for the Hudson River, which were 2.06 (2010) and 2.01 (2011) (Table 3). Seasonal variation is also prominent among several species. According to 2010 data from the Hudson River, the Banded Killifish were at their highest abundance in April; the American Eel, Atlantic Tomcod, Northern Pipefish, White Perch, Blue Crab, and Grass and Sand Shrimp were at their highest levels in May; June saw the highest abundance of Anchovy (Bay and Striped), Striped Mullet, and Winter Flounder; August had the greatest abundance of Atlantic Silversides; Mummichogs were at their greatest abundance in September, and Moon Jellies and Striped Bass were at their peak numbers in October. The greatest overall abundance was in August. The BBPC (East River) data set revealed similar patterns of abundance of Anchovy and shore and grass shrimp which were highest in May (2011) and the greatest abundance of Atlantic Silversides was in August (2010-2011). Rank abundance data for the ten top species show an overlap of seven out of ten species in the Hudson versus the East River Table 4).

Discussion

The results from this study depict a successful pilot public participation in scientific research program. Many students from all age groups participated in the data collection and analysis along with two research scientists and two educators that has lead to a more rigorous recording of baseline biomonitoring of fish and macroinvertebrates at two locations in the East and Hudson Rivers.

Species richness and diversity of the Hudson River (based on 92 hours of

Table 1. Hudson River "Catch of the Day" data from 2010

	Abundance (92 hours of effort)							
Species (2010)	**Apr**	**May**	**June**	**July**	**Aug.**	**Sept**	**Oct**	**TOTALS**
Anguilla rostrata (American Eel)	2	23	9	3	3	3	2	45
Strongylura marina (Atlantic Needlefish)	0	0	0	1	0	0	0	1
Menidia menidia (Atlantic Silverside)	5	5	14	116	1199	274	242	1855
Microgadus tomcod (Atlantic Tomcod)	0	52	1	0	0	0	0	53
Fundulus diaphanus (Banded Killifish)	107	4	1	3	0	0	7	122
Anchoa mitchilli and Anchoa hesetus (Anchovy (Bay and Striped)	2	118	347	11	2	0	6	486
Pomatomus saltatrix (Blue Fish)	0	12	6	5	5	0	6	34
Alosa spp. (Herring (excl. Shad)	0	7	7	4	0	0	48	66
Fundulus heteroclitus (Mummichog)	18	16	22	7	27	44	28	162
Gobiosoma bosc (Naked Goby)	0	6	0	1	3	1	1	12
Syngnathus fuscus (Northern Pipefish)	8	26	10	13	16	7	0	80
Urophycis regia (Spotted Hake)	0	5	0	0	0	0	0	5
Morone saxatilis (Striped Bass)	8	31	4	100	91	47	114	395
Mugil cephalus (Striped Mullet)	0	0	8	38	0	0	0	46
Pseudopleuronectes americanus (Winter Flounder)	0	3	14	1	1	4	0	23
Mugil curema (White Mullet)	0	0	0	2	0	4	0	6
Morone americana (White Perch)	8	45	5	0	2	6	6	72
Catostomus commersoni (White Sucker)	1	5	0	4	0	0	0	10
Opsanus tau (Oyster Toad Fish)	0	0	0	0	1	2	0	3
Cyanea capillata (Lion's Mane Jellyfish)	0	0	15	0	0	0	0	15
Aurelia aurita (Moon Jelly)	7	0	4	32	154	11	697	905
Mnemiopsis leidyi (Comb Jellies)	0	9	54	36	82	43	34	258
Mya arenaria (Soft Shell Clam)	7	3	0	1	6	0	0	17
Callinectes sapidus (Blue Crab)	158	569	162	52	57	226	57	1281
(Crayfish)	0	1	4	0	0	0	0	5
Palaemonetes spp. and Crangon setemspinosa (Shrimp (Grass & Sand))	137	758	472	198	281	574	286	2706
Totals	**468**	**1698**	**1159**	**628**	**1930**	**1246**	**1534**	**8663**

Table 2. East River "Catch of the Day" data from 2011

	Abundance (21 hours of effort)						
Species	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**TOTALS**
Anchoa mitchilli and Anchoa hepsetus (Anchovy (Bay and Striped)	112	23	7	0	8	4	154
Menidia menidia (Atlantic Silverside)	33	10	31	91	90	5	260
Microgadus tomcod (Atlantic Tomcod)	5	2	2	0	0	0	9
Pomatomus saltatrix (Blue Fish)	0	2	2	0	0	0	4
Alosa spp. (Herring (excl. Shad))	11	5	5	0	50	0	71
Trinectes maculatus (Hogchoker)	0	0	1	0	0	0	1
Gobiosoma bosc (Naked Goby)	0	0	0	0	1	0	1
Menticirrhus saxatilis (Northern King-fish)	0	0	0	0	1	0	1
Syngnathus fuscus (Northern Pipefish)	2	2	2	0	1	0	7
Opsanus tau (Oyster Toad Fish)	0	0	0	1	1	0	2
(Skillet Fish)	0	0	0	0	1	0	1
Morone Saxatilis (Striped Bass)	6	0	1	0	17	9	33
Morone americana (White Perch)	0	0	1	0	0	0	1
Pseudopleuronectes americanus (Winter Flounder)	2	2	2	0	2	1	9
(Hydroid)	0	0	1	0	0	0	1
(Hydromedusae)	0	0	0	0	4	0	4
Aurelia aurita (Moon Jelly)	2	0	35	0	50	1	88
Mnemiopsis leidyi (Comb Jellies)	48	23	140	85	100	35	431
(Tube Worm)	0	0	2	0	0	0	2
(Snail)	0	3	81	2	50	0	136
Crassostrea virginica (Oyster)	0	4	4	4	9	0	21
(Amphipod)	2	0	0	0	0	0	2
Callinectes sapidus (Blue Crab)	10	9	12	4	6	0	41
(Decoration Crab)	0	0	1	0	0	0	1
(Green Crab)	1	0	1	0	5	0	7
(Hermit Crab)	1	0	0	0	1	0	2
Palaemonetes spp. and Crangon setemspinosa (Shrimp (Grass & Sand))	71	45	56	0	0	0	172
(Isopod)	1	0	0	0	0	0	1
Botryllus schlosseri (Golden Star Tunicate)	0	1	1	0	0	0	2
(Sea Squirt)	0	0	25	0	50	0	75
TOTALS	**307**	**131**	**413**	**187**	**447**	**55**	**1540**

Table 3. Rank Abundance data (top 10 species)

Hudson River (2010)			East River (2011)	
1	2706	Shrimp	431	Comb Jellies
2	1855	Silverside	260	Silverside
3	1281	Blue Crab	154	Anchovy
4	905	Moon Jelly	172	Shrimp
5	486	Anchovy	136	Snail
6	395	Striped Bass	106	Sea Squirt
7	258	Comb Jellies	88	Moon Jelly
8	162	Mummichog	71	Herring
9	122	Banded Killifish	41	Blue Crab
10	80	Northern Pipefish	33	Striped Bass

Table 4. Shannon Weiner Diversity Index

	2010	2011	Comments
Hudson River	2.06	2.01	Represents 92 hrs. of effort in 2010 over 7 months; 47 hrs. of effort in 2011 over 4 months
East River	1.38	2.26	Represents 3 hrs. of effort in 2010; 21 hrs. of effort in 2011 over 6 months

catch abundance data) appeared to be initially higher than that of the East River, which was based on only three hours of effort. This was because, previous to 2011, the data obtained from the Brooklyn Bridge Park/East River contained only presence / absence data. The

St. Francis College students were the first to record relative abundance data and catch/unit effort beginning in the East River in 2010. The lack of relative abundance data was rectified in 2011 because the Brooklyn Bridge Park Conservancy now uses the same “Catch of the Day” form for the East River as that used by the Beczak Environmental Education Center on the Hudson River. The amount of effort in which abundance was recorded in the East River thus rose from 3 to 21 hours from 2010 to 2011. However, total East River effort was still less than half of that of the effort on the Hudson River. This could be because the sampling beach under the Manhattan Bridge is completely covered during high tide. What have we learned from this project and how can we use these results to further improve our outcomes? Further objectives are multifold:

1. Increase the number of sampling dates (and thus the number of participants) to acquire additional data to analyze for trends.
2. Pay special attention to trends such as bundance of invasive species such as the Asian shore crab (*Hemigrapsus sanguineus)* found increasingly in the East River, not reported last year in the Hudson River/Yonkers data.
3. Recruit additional SFC students to participate in summer research projects involving seining. These

might include stomach content analysis to gain knowledge of trophic interactions, sampling for genetic diversity as was done[9] taking weight and length measurements to assess species variation both within and among species.

4. Devise assessments that would measure student learning, interest in science and sense of stewardship such as pre-and post tests on estuary vocabulary and attitude toward the estuary.
5. Disseminate knowledge gained from conducting research aided by public participation, both scientific and sociological
6. Expanding this model to include additional scientists, information technologists and organizations that conduct seining programs, such as the New York City Park Rangers programs at Orchard Beach in the Bronx, Liberty State Park in New Jersey, and the Salt Marsh Nature Center in Brooklyn, NY.

This partnering should aid in helping to promote a consistent scientific collection database over time. Seasonal patterns can be better understood, as well as indices including species richness, Shannon-Weiner biodiversity index, and rank-abundance curves.

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The Autism Controversy:
Anecdotal Reports, Court Cases and Books vs. Scientific Investigations

by

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The Autism Controversy: Anecdotal Reports, Court Cases and Books vs. Scientific Investigations

The conflict between anecdotal reports and scientific findings is exemplified by studies of autism spectrum disorder (ASD). As discussed later in this report, parental and pediatrician accounts concerning the onset of this debilitating disorder often contradict findings based upon scientific research.

Background

Let's examine a study showing an increase in ASD over the last decade. A national phone survey of 96,000 parents conducted in 2011-12, reported that the ASD rate in the U.S. has risen to 1 in 50 children, ages 6 through 17[1]. There are still questions not yet answered as to the actual ASD rate and its increase, as measured by physicians and medical records. The Center for Disease Control (CDC) has seen a 72% increase in ASD diagnoses within the past four year[2].

Crucial questions remain unanswered about the causes of ASD, both prenatal and postnatal. Manifestations of ASD are wide-ranging, leading scientists to investigate both genetic and environmental causes for this disorder, characterized by difficulties in associating and interacting with other people, as well as other debilitating problems.

It appears that the rise in autism rates parallels the increased use of chemicals since WWII. Over 80,000 chemicals, many of them untested, are in use today. At least 200 of these chemicals are neurotoxic in adult humans and 1000 more have this affect in laboratory models. The National Institutes of Health (NIH) has initiated The National Children's Study of 100,000 children to determine how environmental factors affect children's development, both in the womb and after birth.

Some of the probable causes for ASD involve:

Genetics- Scientists have identified as many as 20 genes associated with ASD. In addition, twin studies have shown that if one twin has ASD, the chances that the other twin has this disorder are increased.

Pesticides- Chemicals found in pesticides could interfere with genes involved in brain development in genetically predisposed children.

Pharmaceuticals- Pre- or post-natal exposure to a myriad of pharmaceuticals could lead to abnormalities in brain development.

Parental Age- There is a 50% higher risk of ASD in children of older parents.

Brain development- Fluctuations in brain neurotransmitters or hormones, such as serotonin or oxytocin, could be associated with ASD mood swings, cause inappropriate behaviors, or interfere with mental concentration[3].

Abnormal Placentas- Another probable cause recently implicated in development of ASD involves abnormal placentas. A study at Yale School of Medicine and the MIND Institute at the University of California, Davis, have identified abnormal placentas of newborns as predictors of the occurrence of ASD in the children's ensuing years. Dr. Harvey Kliman and associates examined 217 placentas. They compared 117 placentas from infants born from at-risk families (families who have previously had a child with autism) with 100 control placentas. The comparison showed significant differences between the groups. There was a 96.7% probability that the infant is at-risk for developing ASD if the placenta has multiple abnormal folds and many inclusions. A normal placenta shows many folds and few inclusions[4]. This is the first study to predict at birth those children who are in danger of developing ASD[5].

The Controversy

Wherein originates the controversy between anecdotal observations and scientific inquiry? The conflict originated with a study done in 1998 by Andrew Wakefield and reported in the *British Journal of Medicine* that reportedly found an autism-vaccine link. Although widely discredited[6], scientists are still researching the vaccine controversy. Approximately one-third of parents continue to express concerns regarding the affect of vaccines on children's health and welfare. This includes parents who observed their child's behaviors change after receiving multiple vaccines in short periods of time. Often these children are later diagnosed as having ASD.

Recently, to add fuel to the fire, the federal Vaccine Injury Compensation Program, known as vaccine court, awarded millions of dollars to 2 children with ASD. The government has not stated that vaccines cause ASD. In these cases, anecdotal observations from parents, grandparents, friends and neighbors attested to the fact that these two children were developing normally until they had severe reverse reactions to vaccines with which they were injected. One child developed encephalopathy as a result of the MMR and other vaccinations. He later developed asthma and ASD. The U.S. Health and Human Services (HHS), defendant in this case, agreed that the child did suffer encephalopathy within five days following receipt of MMR (measles, mumps and rubella combination) vaccine. The other child received compensation for a seizure disorder, a form of ASD, caused by a reaction to the DTaP (diphtheria, tetanus, pertussis) vaccine. According to parents, etc., she had shown no signs of any disorder prior to taking the vaccine. "HHS did not admit that vaccination caused encephalopathy or autism, but merely decided not to dedicate more resources to defending the case." HHS has never admitted that autism is caused by vaccinations[7].

Another twist to the vaccine/ASD story is the use of the preservative thimerosal (contains ethyl mercury) in some vaccines. This preservative is often used to prevent *Staphylococcus* infections that might contaminate some vaccines. The MMR, Varicella and Polio vaccines never contained thimerosal in the past or present[8]. Many parents may still believe that these vaccines did contain the preservative and that it caused their

children to develop ASD following vaccinations. In any case, there are conflicting studies as to whether thimerosal is linked to the ASD cases[8].

Dr. Cave, in her book on children's vaccines[8], points out that children receive more than 45 doses of fourteen vaccinations by the age of five years (p.11). She believes that giving that many vaccinations to children, whose immune systems are in an immature state, may adversely affect them and might cause ASD to develop.

Scientific investigations are based upon falsification. Comparisons are made between equivalent groups where the independent variable is being tested and the dependent variable is being measured. On the scientific inquiry side of this controversy there are numerous recent studies on vaccination.

For example, a 2003 study by Hviid, *et al*., was performed to determine whether vaccination with a thimerosal-containing vaccine is associated with development of autism. The groups studied were all children born in Denmark from 1990 to 1996 (N=467,450). One group was vaccinated with a thimerosal-containing vaccine and the other group was vaccinated with a thimerosal-free vaccine of the same kind. The risk of ASD did not differ significantly between the two groups. There was also no evidence of a dose-response association[9].

A French safety assessment of squaline (an adjuvant) and thimerosal in vaccines by Montana, *et al*, in 2010, reviewed clinical trials data comparing adjuvanted influenza vaccines and non-adjuvanted influenza vaccines. In this study, there was no convincing evidence that exposure to thimerosal in vaccines had any adverse affects on recipients[10].

In 2010, Price, et al., performed a case-control study of 256 children with ASD compared with 752 controls matched for age, gender, and managed care organizations. Exposure to thimerosal in vaccines and immunoglobulin preparations was determined from electronic immunization records, medical charts, and parental interviews. Their study showed no relationship to increased risk of ASD from thimerosal-containing vaccines and immunoglobulin preparations[11].

A definitive case-control study by Destefano, Price and Weintraub, published in 2013, evaluated the association between autism and the level of immunological stimulation received by children in their first two years of life from vaccines. They used the same children as in the 2010 study discussed above. The antigen content of vaccines received was obtained from immunization and medical records. In their investigation, increased exposure to antigens in vaccines during the first two years of life was not related to developing autism. "The risk of autism is not increased by too many vaccines too soon[12]."

Both Sides of the Controversy

To be fair to parents of ASD children, one must say that Cave's book does raise some critical issues about the safety of some vaccines and their contents. For example, she points out (p.121) that the hepatitis B vaccine is given to all newborns, despite the fact that less than 1% of babies are born to women who might be infected[8]. Is it really essential to expose infants to this vaccine, when only 0.001% of children (1996 data) were born with the infection[8]?

More research must be done by governmental agencies, like the CDC, NIH, etc., as well as private and academic concerns, in order to determine to safety of existing and also new vaccines before the public is exposed to them. These agencies that perform these tests must not be under the influence of the pharmaceutical companies that provide these vaccines. Cave alleges that this situation has occurred in the past. For example, she

points (p. 36) to the fact that the Chair of the rotavirus working advisory group also served on Merck's advisory board and owned stock in Merck. Also, 3 of the 5 FDA committee members who voted for the rotavirus vaccine had conflicted interests. These conflicts of interests must not be allowed or the oversight process on vaccines is invalid.

It is true that vaccines have been used successfully to prevent diseases. Certainly, in the last hundred years the infant and childhood death rate has declined dramatically. However, one must always keep in mind that any kind of pharmaceutical may cause adverse reactions in some individuals. This is unfortunately the case. Just listen to the disclaimers at the end of the commercials for any drug that is being advertised on TV. Does that mean that nobody should take those drugs? The answer to that question is obvious. It is tragic that some children exposed to certain vaccines have devastating consequences. When the harm outweighs the benefit, then the pharmaceutical agent should be removed. The case in point is the use of the smallpox vaccine. It is no longer given for the very reason that smallpox has been eradicated and that the vaccine itself can be fatal to some recipients. (It is estimated that 1 or 2 people in 1 million (0.000198%) who received the vaccine could die as a result of encephalitis[13]. Medical science has given us many tools to keep us healthy, however, there are always risks associated with these tools. We have to use them judiciously.

There are still many questions to be raised and answered concerning the causes, prevention, and treatments of ASD in our children. As a person who has three children in her family who have been diagnosed as having ASD, I am more than mildly concerned with finding answers.

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Biodiversity and Food Web Diagram for Lake Michigan

by

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Introduction

Biodiversity refers to the number of species within a certain area, which can be used as a measure of the health of an ecosystem. Such biodiversity helps the ecosystem to function in a healthy balance for all of its inhabitants. An ecosystem is a community of living organisms and non-living materials and their surroundings. It consists of plants, animals, microorganisms, soil, sunlight, minerals that depend on interactions that influence the continuum of its health and survival[1].

In the United States, the four key ecosystems include: 1. Puget Sound, 2. Columbia River, 3. The Great Lakes; and 4. The Gulf of Mexico. This report addresses only the ecosystem of the Great Lakes, in particular, Lake Michigan. There are five lakes, collectively called the Great Lakes: Huron, Ontario, Michigan, Erie, and Superior (HOMES), bordering eight states and two Canadian provinces[2].

Lake Michigan ecosystem was chosen for this report because it is the only one of the five lakes located entirely in the United States, the others border the United States and Canada. Lake Michigan represents the largest surface freshwater system in the world. A population of 33 million people depend on the Great Lakes for its life form for food and freshwater. Its ecosystem is unique and constantly undergoing changes to maintain the support needed for marine and terrestrial survival and balance. Air, water and human pollution may upset the balance in both aquatic and terrestrial life[3].

According to Britannica online (2008), "[a Lake is] any relatively large body of slowly moving or standing water that occupies an inland basin of appreciable size. Definitions that precisely distinguish lakes, ponds, swamps, and even rivers and other bodies of nonoceanic water are not well established. It may be said, however, that rivers and streams are relatively fast moving; marshes and swamps contain relatively large quantities of grasses, trees or shrubs; and ponds are relatively small in comparison to lakes. Geologically defined, lakes are temporary bodies of water[4]."

The U.S. Army Corps of Engineers website lists different levels of depth and connection of the lakes and the water flow finally into the Atlantic Ocean as illustrated in Fig. 1.

LAKE MICHIGAN ECOSYSTEMS

Lake Michigan is home to diverse ecosystems that include terrestrial and aquatic environments. Basically, an ecosystem comprises a community of species of flora and fauna that make the ecosystem of Lake Michigan diverse and unique. Similar to all large bodies of water, trophic levels in an ecosystem include quaternary, tertiary, secondary, and primary consumers, along with

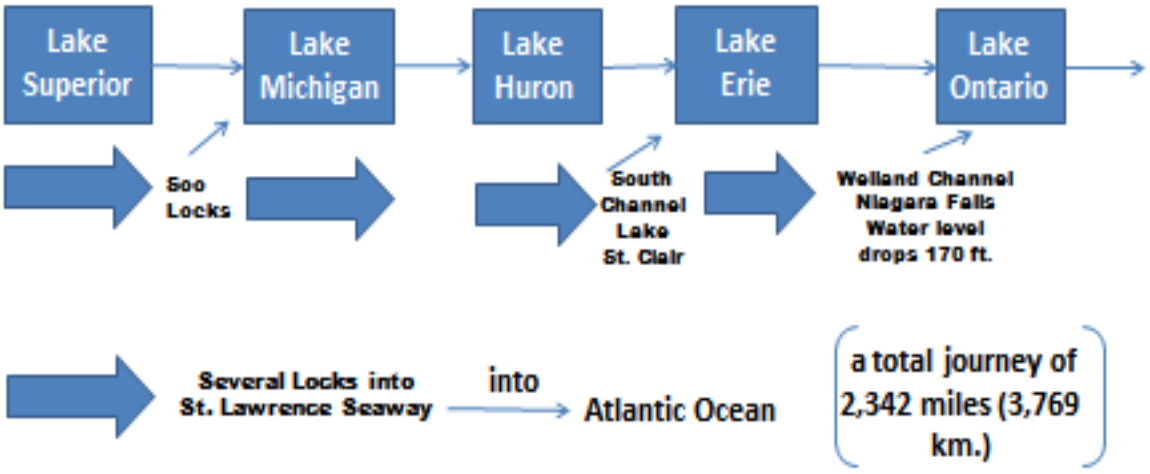

Fig. 1. The flow of water through the five Great Lakes to the Atlantic Ocean[5]

primary producers. The species within the ecosystem interact in a flow of energy unique to it, known as a Food Web. Both biotic and abiotic factors influence the balance and the success of such ecosystem. Abiotic factors in Lake Michigan depend on maintaining a temperature between 60 to 90 degrees, and winds that keep the water moving so it does not freeze over and destroys marine life, available oxygen, solar exposure or available sunlight, and the amount of rainfall[6].

Lake Michigan is home to a variety of plant and animal species, the biotic elements of the ecosystem. The major plant species include grasslands, forest, and wetlands. All species within this ecosystem interact to make it sustainable over continuous time periods. Marshes, tall grass prairies, forest sand dunes, grow deep in its basin and serve as a habitat for wildlife[7,8].

Many species of fishes inhabit its lower peninsula where the temperature is warmer: trout, chinook salmon, walleye, crawfish, sponges, sea lampreys, and eels live there. Birds include ducks, geese, sea gulls, swans, crows, bald eagles, hawks, and vulture feast on its wildlife. Some animal inhabitants include snakes and frogs[8,9].

Lake Michigan biodiversity encompasses a number of species living in their habitat and is a measure of the health of such ecosystem. Diverse species make a healthier ecosystem. This means, the living species are critical to the functioning of its environment. For example, for an ecosystem to benefit its life, it depends on all the physical and chemical ecology maintaining a balance.

The diagram of the lake's food web (Fig. 2) is the calorific flow energy through the food chain. The diagram quantifies the relative importance of different species and their feeding relationships. Therefore, the food web energy begins with green plants (photoautotrophs) called primary producers that fix solar (sunlight) energy by a process of photosynthesis and stores its own energy for survival.

Primary consumers such as zooplanktons (small animal species) and frogs get energy from phytoplanktons through digestion, and transform the energy via adenosine triphosphate (ATP) and

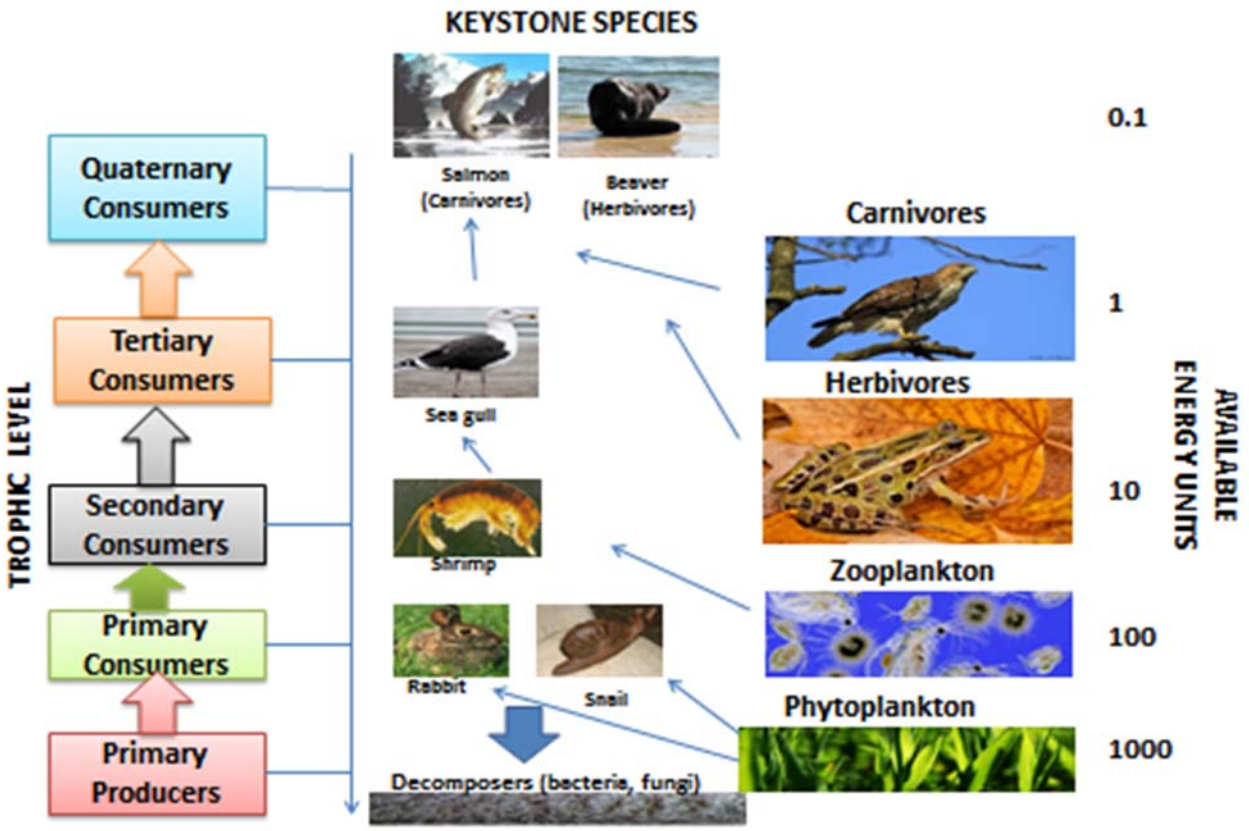

Fig. 2. Food Web Species, Trophic Levels and Available Energy Units

respiration, which is lost from the system. Herbivores get energy by consuming plants. The loss of energy is greater in warm-blooded animals, and they must eat more frequently to get enough energy, than cold-blooded animals[10].

Secondary consumers, carnivores, consume primary consumers, although omnivores consume both plant and animal material. Energy used by primary consumers is absorbed by secondary consumers through digestion. They convert their energy into ATP through respiration. Some of its energy is lost from the system through respiration, and body temperature cannot be utilized by secondary consumers[10].

Tertiary consumers such as the sea gull consume secondary consumers with some energy absorbed and some lost. This level may or may not have keystone predators to maintain the ecosystem or by quaternary consumers.

The Keystone Species that Maintain Lake Michigan Ecosystem are Salmon and Beaver

BEAVER AS A KEYSTONE SPECIES

Beaver (*Castor canadensis*) is a fat-bodied, nocturnal, gonochoristic, semi-aquatic animal that lives in lodges in a water environment[11]. The ears are short and

round, brown in color and underfur gray with a coarse surface fur. It has a large front tooth that grows throughout the life of the animal. The upper incisors are brown-orange and long, closable nostrils, closable ears and transparent eye membrane that is suitable for its aquatic environment[12].

Their tail is flat, scaly, and hairless. Both male and female beavers have anal and castor glands, located at the base of the tail. The scent from these glands is used as a scent-marker for their territory[12]. The female usually gives birth to 3-4 young called kits. The young remain with their parents for two years. The young then leaves their parents to build their own dam. The adult size is a deterrent to most predators such as bears and wolves[13].

Beavers are herbivores. They eat only plants, such as all sorts of grasses, twigs from trees, clover, aquatic plants, and water lilies. As powerful keystone species, they create a watery habitat for wildlife, such that downstream water is purified of toxins, microbes, and pesticides. Therefore, their lifestyles of dams support biodiversity in Lake Michigan[14]. Beavers are found throughout the United States except northern Canada and southern United States and Mexico. They take up residence near lakes, swamps, wetlands, and other water environments and build a dam to suit their liking. The dams are built from brush, rocks, wood, metal, trees, plastered with mud and other material. Trees are destroyed to establish an ecosystem, since dams slow the flow of water in fast streams. The dams slow the flow of flooding, preventing erosion, which raise the water table and act as a purifying system of water by reducing chemical toxins[13].

CHINOOK SALMON AS TOP PREDATORS

Chinook Salmon (*Orcorhynchus tshawytscha*), means “hook nose”, is anadromous. This predator is not native to Lake Michigan, but was introduced in the 1960s by stocking to help restore the lake trout population that was decimated by the sea lamprey. As carnivores, the salmon was introduced to control the alewife population and to maintain the food web. They feed on copepods, jellyfish, and starfish. They inhabit freshwater streams and estuaries. These fish need fresh, oxygenated water to lay eggs and to gain energy to inhabit ocean waters[15,16].

Chinook salmon spends one to eight years at sea, then returns to natal streams to spawn. After laying eggs the female guards their redds (nests) for about 25 days before dying. When salmon die, the nutrients they brought from the ocean, rich in oxygen, nitrogen, carbon, sulfur, and phosphorus enrich the terrestrial ecosystem. When carnivores, such as the grizzly bear eat part of captured salmon in wooded areas, the remainder decomposes to supply the soil with nutrients for plant growth. Overfishing decreases the salmon population and cause an imbalance in the food web chain inter-relationship. As keystone species, salmon supports wildlife species in Lake Michigan[15]. Humans fish for fresh salmon to eat because of high levels of omega-3-fatty acids, vital for normal metabolism, and anti-aging properties.

The final link in the food chain are decomposers (detritivores – bacteria and fungi) that break down organic matter from dead material from all trophic levels contributing nitrogen and carbon dioxide to be recycled.

Trophic levels in the diagram estimate amount energy passed on from one feeding level to the next. Primary consumers get 10% of the energy produced by photoautotrophs. Secondary consumers get 1%, and tertiary consumers get only 0.1%, such that the top predators or keystone species in a food chain receives the least energy because of the loss of energy between trophic levels; and therefore, must constantly depend on the primary producers for energy[17].

AIR, WATER, AND HUMAN POLLUTION RISKS TO LAKE MICHIGAN ECOSYSTEM

Lake Michigan water is a major source of fishing and freshwater for human use. Biological and chemical contaminants can cause serious consequences to the ecosystem, especially when in the tissues of fish from the air and water and consumed by humans and other species. Health problems such as birth defects have occurred in humans and animals, and almost exterminated the American bald eagles[18].

Tree and air pollution are a high risk to the ecosystem due to toxic gases released from trees and industry power plants[19]. According to EPA (2013) some pollutants have shown to cause a decline in fish egg production in female and male fish acquired female characteristics.

Mercury toxicity has been a major concern in fish and humans who consume fish and has increased since the mid-1980s. Some concerns have been raised in the U.S. Canada, and in European countries about mercury in game fish. Mercury is known to cause toxicity to the central nervous system. Concerns arise when the concentrations exceed 1.5 ppm standards in Lake Michigan. Scientists are faced with the challenge as to how mercury in toxic and near-toxic levels end up at the top of the food chain. Mercury as an element is widely dispersed around the earth. It enters waters by various means. For example, in paper mills, mercury is used to reduce slime waste during production, and to separate chlorine from saline solutions[20]. The EPA found that when mercury comes in contact with bacteria, it forms the inorganic product called methyl mercury, which is poisonous to fish and to human who eat the contaminant fish[21].

Polychlorinated biphenyl (PCB), ubiquitous in Lake Michigan, is a major concern in watersheds because of its low water solubility. Although PCB was banned in the 1970s, levels can still be measured in Lake Michigan. However, efforts are underway to monitor and reduce its level in the lake[18].

The pesticide, DDT, was found in the Lake Michigan food chain. The highest concentration was detected in the fatty tissue of sea gulls, tertiary consumers that feed on fish that eat small insects. The effect of DDT in bird species was seen in the eggshell production. The concentration was responsible for a sharp decrease in the sea gulls population due to the weight of the bird on the thin-shelled eggs that were damaged during incubation. The biomagnification of DDT tissue concentration in sea gulls was 240 times that of small insects inhabiting the same environment. This causes the concentration to increase at each link in the food chain, so that the top predators , if they are fish, would be so contaminated to be unfit for human consumption[22].

Agriculturally, phosphates are used in fertilizers to grow crops, but phosphates included as laundry detergent brighten and clean clothes. The runoff from sewage into lakes was found to cause the

overgrowth of plants and create algal bloom on surface waters. Plants deep in lake basins could not get sufficient sunlight and died, creating an imbalance in the ecology of aquatic life. When dead plants decompose, they deplete oxygen in the water, killing fish and other aquatic life. This is called eutrophication. Therefore, in 1993 phosphates were banned from laundry detergents[23,24].

In conclusion, Lake Michigan is home to diverse ecosystems that makes it unique. Lake Michigan was chosen because it is the only one of the five Great Lakes located entirely in the United States. The other four border the U.S. and Canada. It is the largest surface freshwater system in the world and supplies the needs of a large population in eight states.

Trophic levels in the ecosystem include primary producers, primary, secondary, tertiary, and quaternary consumers in which a top predator maintain the balance of energy flow as illustrated in a food web. The diversity that is part of the food web is a measure of the health of the ecosystem that is essential to prevent its collapse. Air and water quality can cause serious consequences to the ecology of the lake. Contaminant such as mercury, PCBs, pesticides (DDT), and phosphates pose a threat not only to marine and terrestrial life, but to health of humans who depend on the lake for food and recreation.

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