

Preliminary Report on Sanitary Water Quality, Shellfisheries and Aquaculture of *Crassostrea tulipa* in the Tanbi Estuary of Gambia, West Africa

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Summary

- Description of Gambian demographic & climatologic data
- Gambia oyster fisheries & Tanbi estuary
- Oyster spat settlement data
- Sanitary water quality data (coliforms)
- Developing a Gambian Nssp and prospects for implementation



Crassostrea tulipa (Lamarck 1819)

Photo source: Wikimedia Commons

Demographics of Gambian Shellfishers

- Shellfishers predominantly women
- Many sole family income provider
- Formation of TRY Women's Association – about 500 members
- Exclusive rights to resource granted in MOU Jan 2012



Value of oysters USA and Gambia



- Prices received are dependent upon consumer confidence
- Great difference in prices received with Gambian woman receiving equivalent of about \$2.00 for whole basket
- Gambians recognize role in NSSP for increasing economic value of oysters

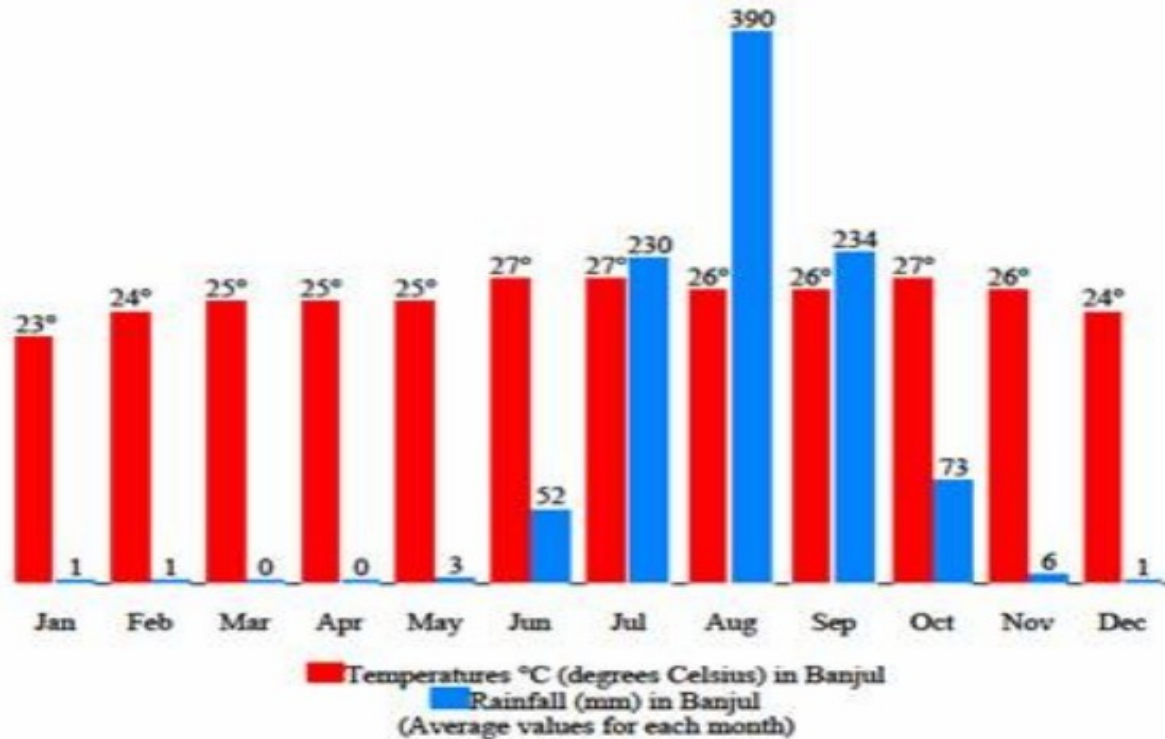


Gambia and Rhode Island

	<i>Rhode Island</i>	<i>Gambia</i>
Area	3,140 km ²	10,380 km ²
% water	13.9%	11.5%
Population	1,050,300	1,705,000
Density	388.0/km ²	164.2/km ²



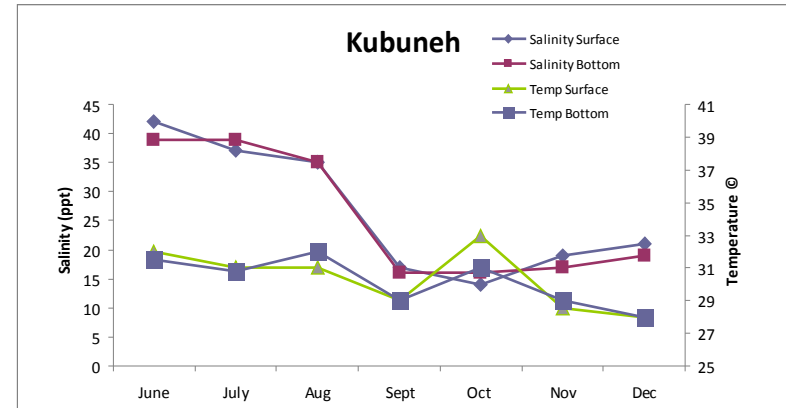
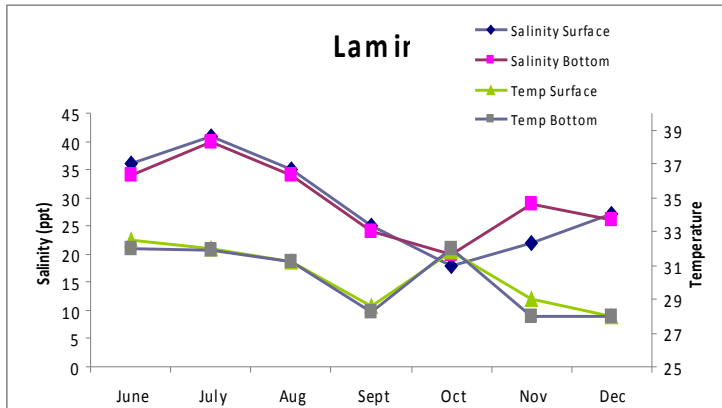
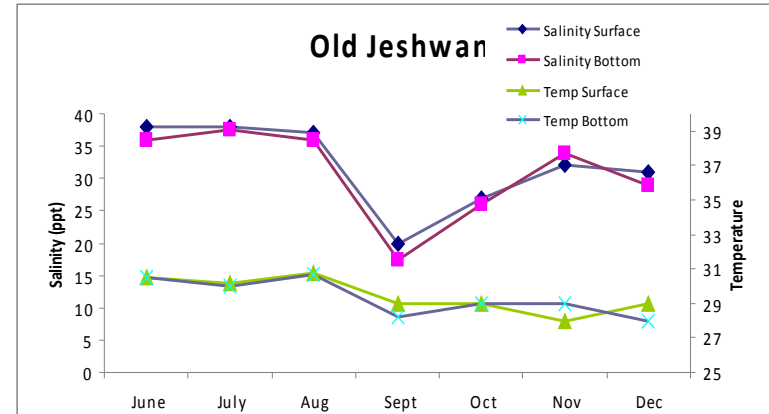
Climatological Data --- Banjul, Gambia



Tanbi Wetlands Complex in Gambia



S-T Profiles at Spat Collection Stations 2011

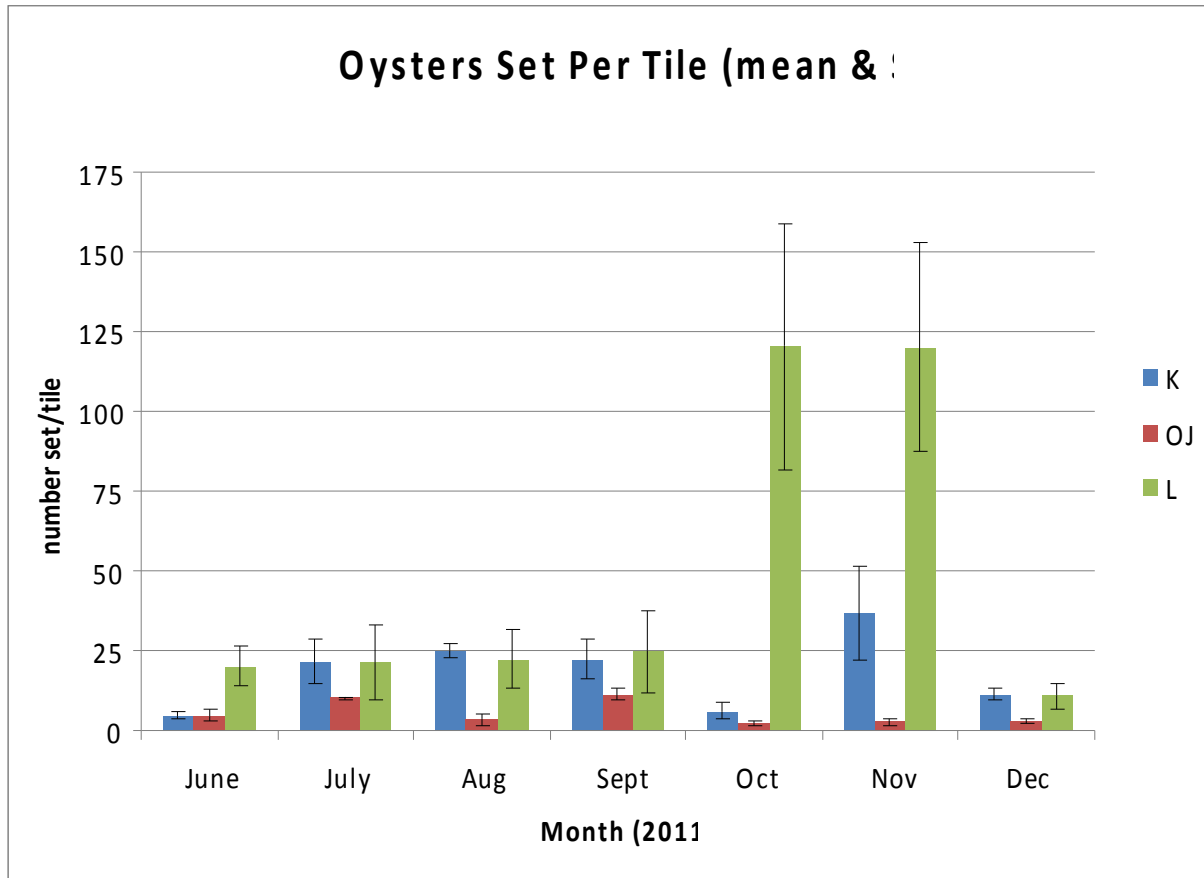


Oyster Spat Collection Studies

- 10 tile spat collectors 15cm x 15cm placed at each site May 2011
- Checked monthly, cleaned & replaced
- Oyster spatfall & nature of fouling data collected until Dec 2011

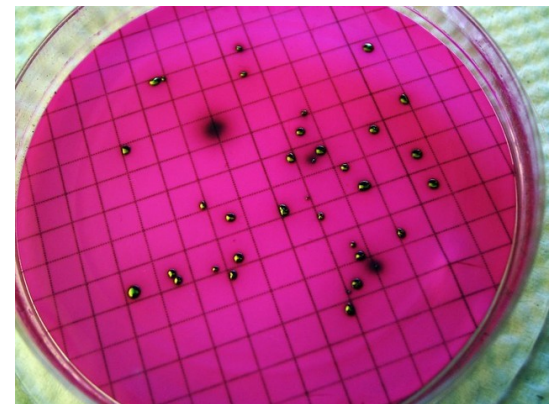


Oyster Spatfall in the Tambi Wetlands



Steps to establish water quality classifications

- Baseline testing of coliform bacteria in Tanbi estuary begun October 2010 & ongoing
- Twice monthly water sampling at 15 sites, parameters measured include DO, temp, salinity, TC by filtration and m-Endo broth incubation method at 37°C, and FC by filtration and LTB at 44°C
- Survey data is multipurpose
 - Prioritization for remediation
 - Establishing water quality classification zones for shellfisheries



Sample Data Sheet 30 March 2011 (dry season)

Project: Ba Naafa Project

Weather Conditions: 30th March 2011 = sunny

Location: Tanbi National Park and West Coast Region

Weather Conditions: 31st March 2011 = sunny

		Test Results		Type of sample: River/Surface Water				
Location	Date	Time	Temp	Temp	Salinity	F C	T C	Sanitary Survey
	ddmmyyyy		°C	°F	‰	no/100ml	no/100ml	
Banjul, Wenchong Bond road, Tanbi National Park	30/03/2011	14:20	31.0	87.8	43.0	24	36	Fairly clean not far from settlements, low tide
Banjul, kamalo opposite Atlantic sea food, Tanbi National Park	30/03/2011	15:11	30.2	86.4	44.5	12	24	Clean surrounding, low tide
Old Jeshwang, behind Elton petrol station, Tanbi National Park	30/03/2011	15:20	29.2	84.5	40.5	28	44	Fairly clean pigs living near the harvesting sites low tide
Ebo Town Badala, Oyster harvesting site, Tanbi National Park	30/03/2011	15:49	29.5	85.1	38.9	28	64	Fairly clean recreational activities on, low tide
Faji Kunda Badala, Oyster harvesting site, Tanbi National Park	30/03/2011	16:37	29.4	84.9	43.6	24	48	Fairly clean recreational activities on, low tide
Abuko Badala, Oyster harvesting site, Tanbi National Park	30/03/2011	16:58	29.3	84.7	45	28	44	Fairly clean surrounding, low tide
Lamin lodge, Oyster harvesting site, Kombo North Western Region	30/03/2011	17:05	26.9	80.4	39.1	8	20	Fairly clean surrounding, high tide
Lamin Daranka, Oyster harvesting site, Kombo north, Western Region	31/03/2011	9:50	27.1	80.7	39.4	12	28	Clean surrounding, high tide
Kerewan Badala, Oyster harvesting site, Kombo North, Western Region	31/03/2011	10:01	27.1	80.7	39.8	4	16	Fairly clean surrounding, high tide
Mandinary Tenda Oyster harvesting site, Kombo North, Western Region	31/03/2011	10:15	27.0	80.6	39.7	8	12	Fairly clean surrounding, high tide
Kubuneh Badala, Oyster harvesting site, Kombo Central, Western Region	31/03/2011	10:34	27.7	81.8	36.7	8	20	Clean surrounding, high tide
Bafuloto Badala, Oyster harvesting site, Kombo Central, Western Region	31/03/2011	11:15	27.7	81.8	37	4	12	Clean surrounding, high tide
Kembujeh Badala, Oyster harvesting site, Kombo Central, western Region	31/03/2011	11:57	30.5	86.9	37.1	16	28	Fairly clean surrounding, high tide
Madinaba Tenda, Oyster harvesting site, Kombo East, Western Region	31/03/2011	12:24	30.9	87.6	33.7	8	16	Fairly clean surrounding, high tide
Kartung Boso Tenda, Oyster harvesting site, Kombo south, Western Region	31/03/2011	13:20	39.0	81.6	39	4	16	Fairly clean surrounding, high tide
Average	Not Available		29.7	84.3	38.0	16	33	

Sample Data Sheet 6 Sept 2010 (wet season)

Project: Ba Naafa Project

Weather Conditions: 7th September 2010 = Drizzle

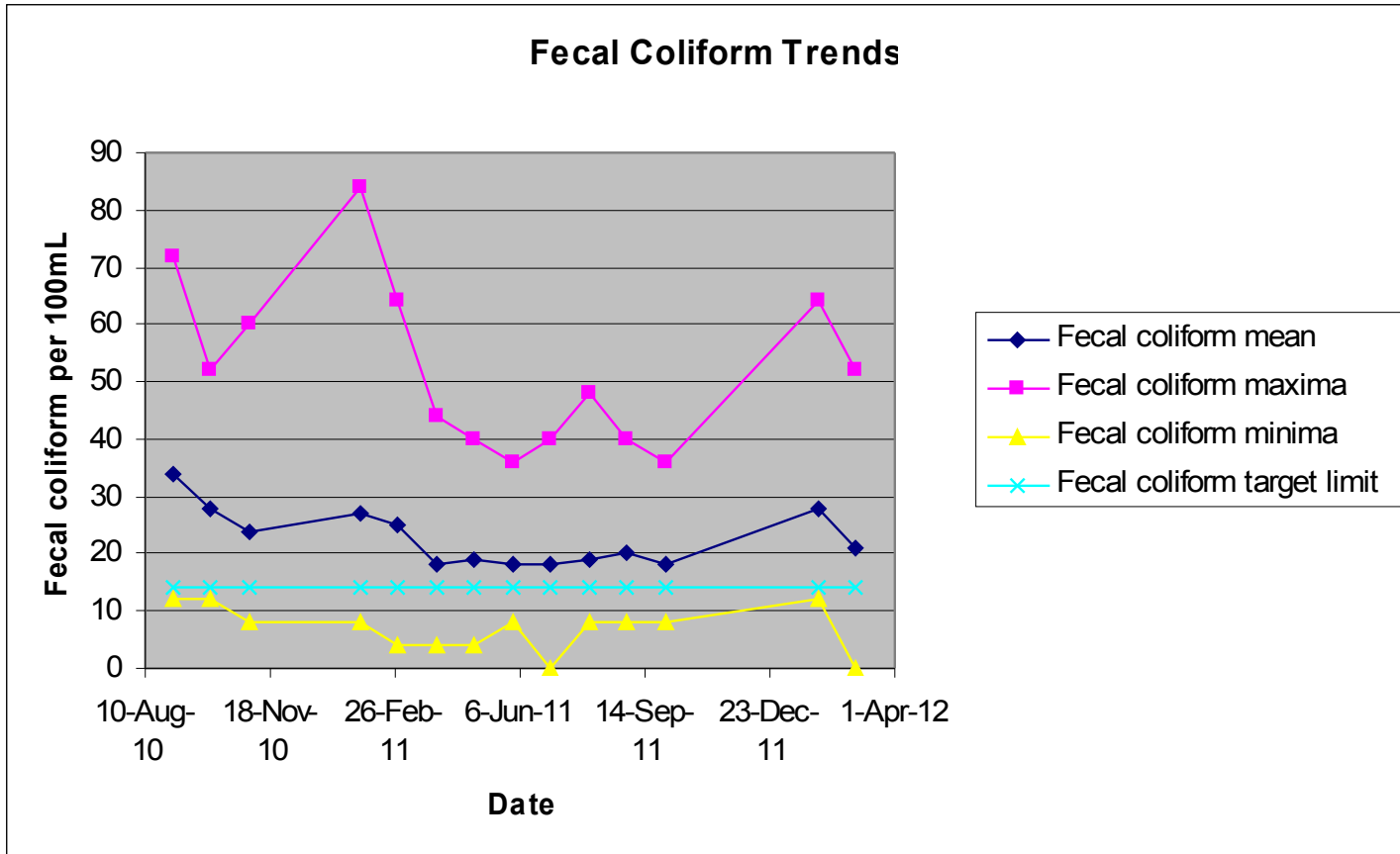
Location: Tanbi National Park and Western Region

Weather Conditions: 6th September 2010 = Drizzle

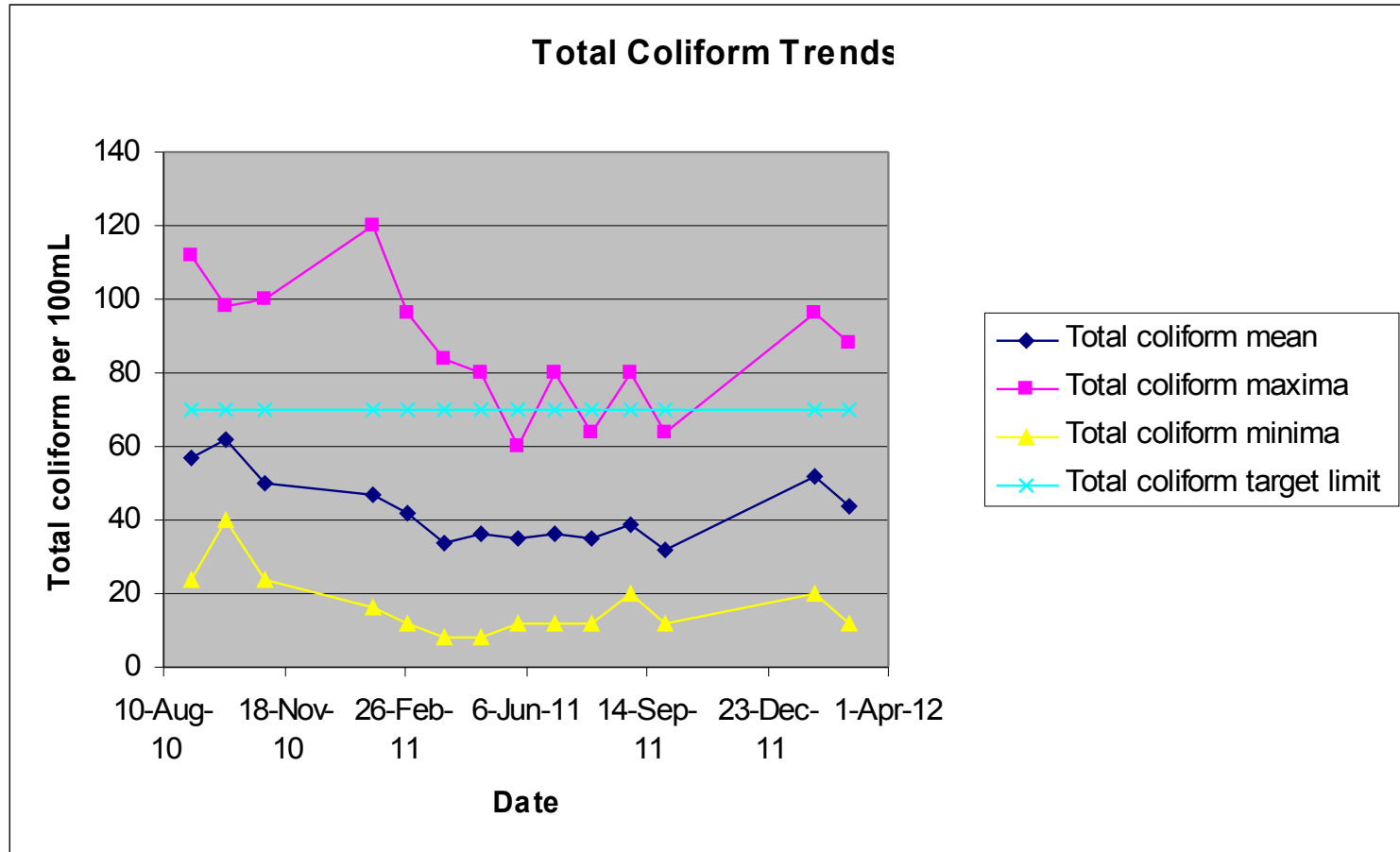
Test Results Type of sample: River/Surface Water

Location	Date	Time	Temp	Temp	Salinity	F C	T C	Sanitary Survey
	ddmmyyyy		°C	°F	‰	no/100ml	no/100ml	
Banjul, Wenchong Bond road, Tanbi National Park	6/9/2010	12:35	27.0	80.6	17.7	64	72	Fairly clean not far from settlements, low tide
Banjul, kamalo opposite Atlantic sea food, Tanbi National Park	6/9/2010	13:01	25.8	78.4	11.9	12	24	Clean surrounding, low tide
Old Jeshwang, behind Elton petrol station, Tanbi National Park	6/9/2010	13:20	26.8	80.2	14.8	72	88	Fairly clean pigs living near the harvesting sites low tide
Ebo Town Badala, Oyster harvesting site, Tanbi National Park	6/9/2010	13:40	26.8	80.3	12.4	20	24	Fairly clean surrounding, low tide
Faji Kunda Badala, Oyster harvesting site, Tanbi National Park	6/9/2010	13:50	26.7	80.1	10.8	28	32	Fairly clean surrounding, low tide
Abuko Badala, Oyster harvesting site, Tanbi National Park	6/9/2010	14:00	26.9	80.4	11.4	52	68	Fairly clean surrounding, low tide
Lamin lodge, Oyster harvesting site, Kombo North Western Region	6/9/2010	14:30	28.9	84.0	16.5	68	76	Fairly clean surrounding, low tide
Lamin Daranka, Oyster harvesting site, Kombo north, Western Region	6/9/2010	14:50	29.1	84.3	16.6	32	68	Clean surrounding, low tide
Kerewan Badala, Oyster harvesting site, Kombo North, Western Region	6/9/2010	15:15	28.9	84.1	16.4	28	64	Fairly clean surrounding, low tide
Mandinary Tenda Oyster harvesting site, Kombo North, Western Region	6/9/2010	15:25	28.9	84.0	16.8	32	56	Fairly clean surrounding, low tide
Kubuneh Badala, Oyster harvesting site, Kombo Central, Western Region	7/6/2010	12:45	27.5	81.5	16.6	16	24	Clean surrounding, low tide
Bafuloto Badala, Oyster harvesting site, Kombo Central, Western Region	7/6/2010	12:13	26.9	80.5	14.5	32	52	Clean surrounding, low tide
Kembujeh Badala, Oyster harvesting site, Kombo Central, western Region	7/6/2010	12:50	28.3	82.9	15.5	24	44	Clean surrounding, low tide
Madinaba Tenda, Oyster harvesting site, Kombo East, Western Region	7/6/2010	13:20	28.4	83.1	14.2	20	32	Clean surrounding, low tide
Kartung Boso Tenda, Oyster harvesting site, Kombo south, Western Region	7/6/2010	14:25	27.1	80.7	18.2	40	60	Clean surrounding, low tide
Average	Not Available		28.0	82.5	16.1	35	54	

Summary Fecal Coliforms in Tambi



Summary Total Coliforms in Tambi



Wait a minute, the data look pretty good!



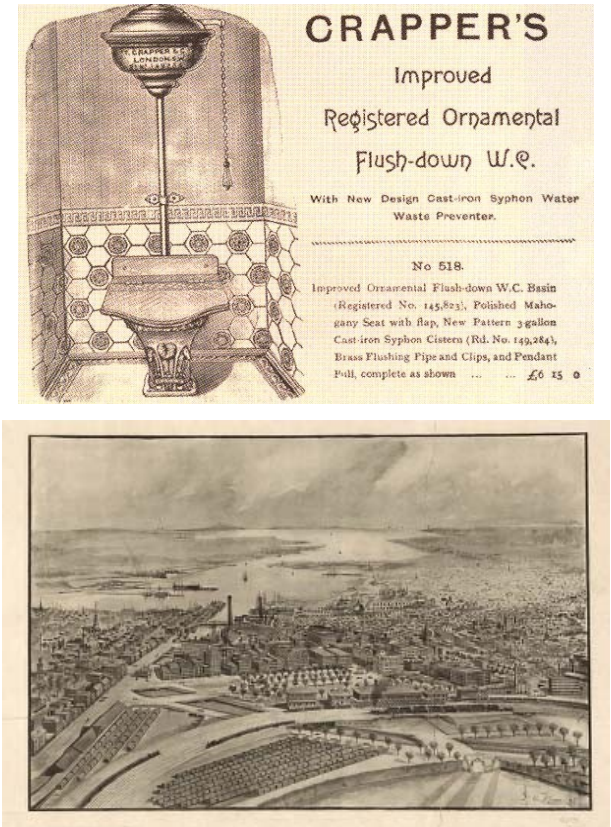
Gambia May be Dumping Far Fewer Wastes into their Estuary than Developed Countries



Manure cleanout “honey wagon” in Thailand

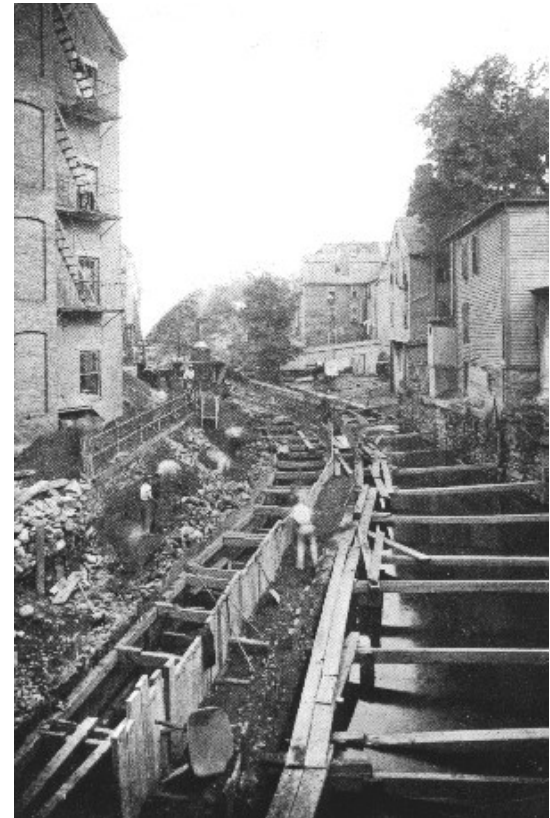
Invention of the flush toilet greatly increases sewage to Narragansett Bay

- 1901
The Providence Sewage Treatment System is put into operation. The chemical precipitation plant, the third of its kind in the United States, is the largest of its type ever built. The system consists of a pumping station at Ernest Street to lift sewage to Field's Point for treatment.



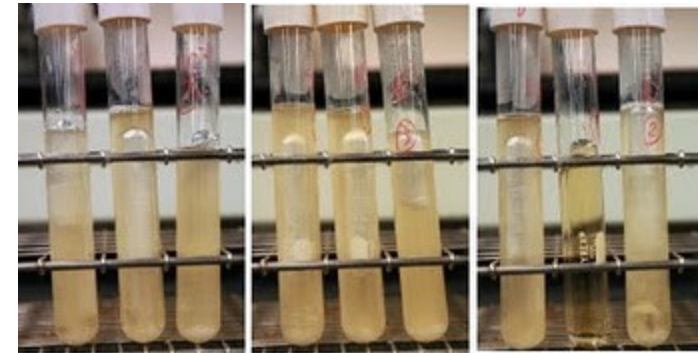
Consequences of the Sewer System

- Incidences of water-borne diseases down 80% or more in the city
- Millions of liters of wastewater into Narragansett Bay
- Increase of bacterial diseases (typhoid & cholera) associated with eating shellfish
- Concerns by public health officials about epidemics
- Several wealthy individuals die from shellfish – calls for action ca1900



Development of the NSSP in the United States

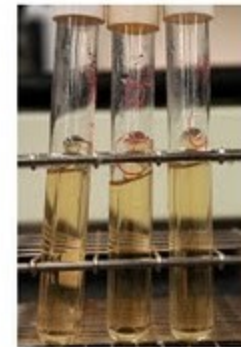
- 1885 Coliforms discovered by Theodor Escherich in Germany
- About 1905 first work to establish sanitary shoreline surveys to spot pollution sources
- The multiple-tube fermentation technique for coliform analysis (McCrary, M.H. 1915. *The Numerical Interpretation of Fermentation Tube Results*. J. Infect. Dis. 17:183)
- NSSP adopted in 1925 by shellfish-producing states



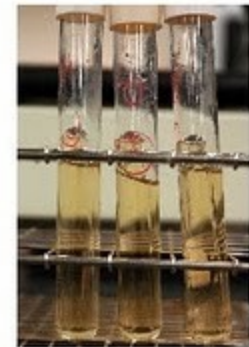
10^{-2}

10^{-3}

10^{-4}

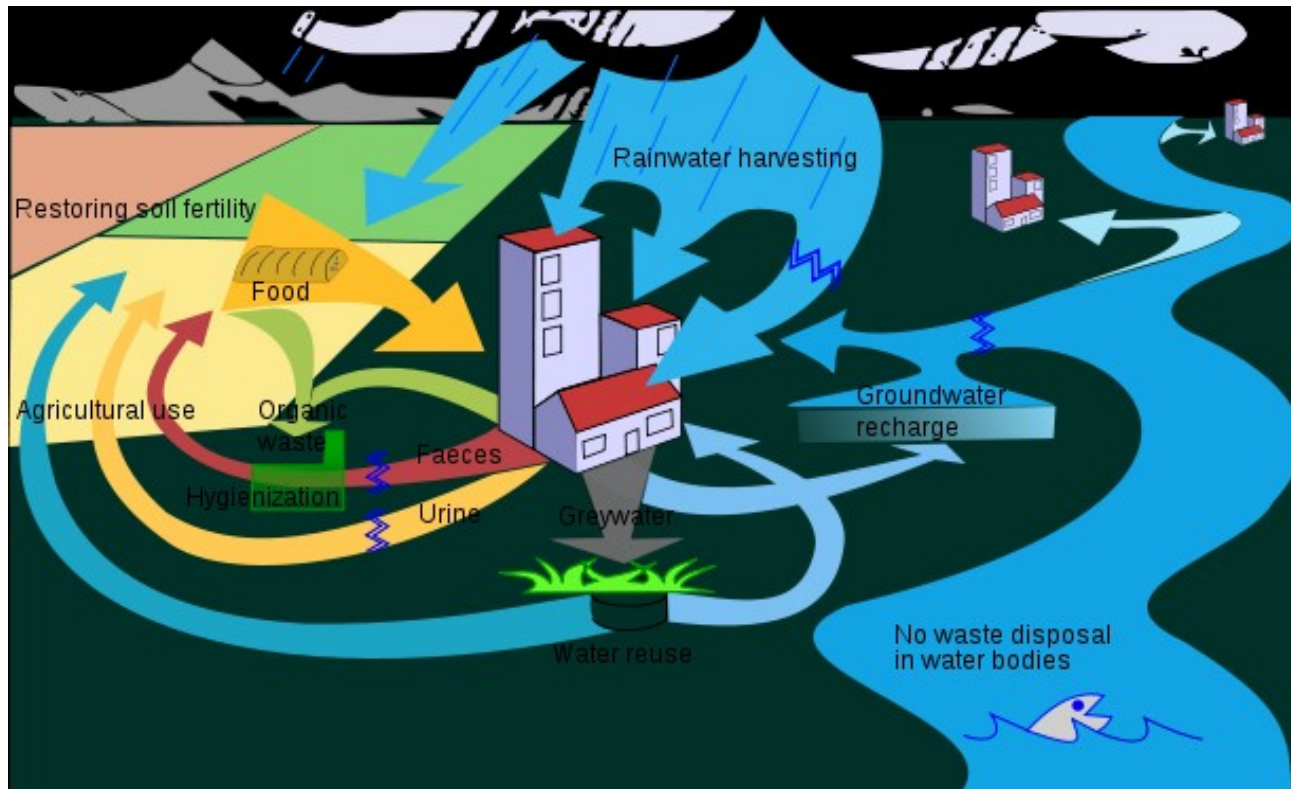


10^{-5}



10^{-6}

Ecological Recycling of Wastes



Gambia may be closer to ideal of recycling than we are in New England --- Tech leapfrogging?

Possible steps for establishing and implementing a Gambian NSSP

Developing Gambian NSSP based on interagency MOU

- Decide specific tasks required for a G-NSSP --- Perhaps use model ordinance as guide
- Develop standard operating procedures for fulfilling required tasks --- Perhaps use RI SOPs for a guide
- Develop MOU as part of the SOPs specifying responsibility of each agency
- Identify funding mechanism for interagency cooperation



Identification and remediation of known fecal contamination

- First, identify, define & map shellfish growing waters
- Pre-identify potential sources of contaminants
 - Google Earth to locate major problem areas
 - Use of local knowledge and public records
- Establish baseline conditions in pre-defined areas by walking the shoreline – pinpoint location by simple GPS device
- Use spreadsheet to establish database of problem areas

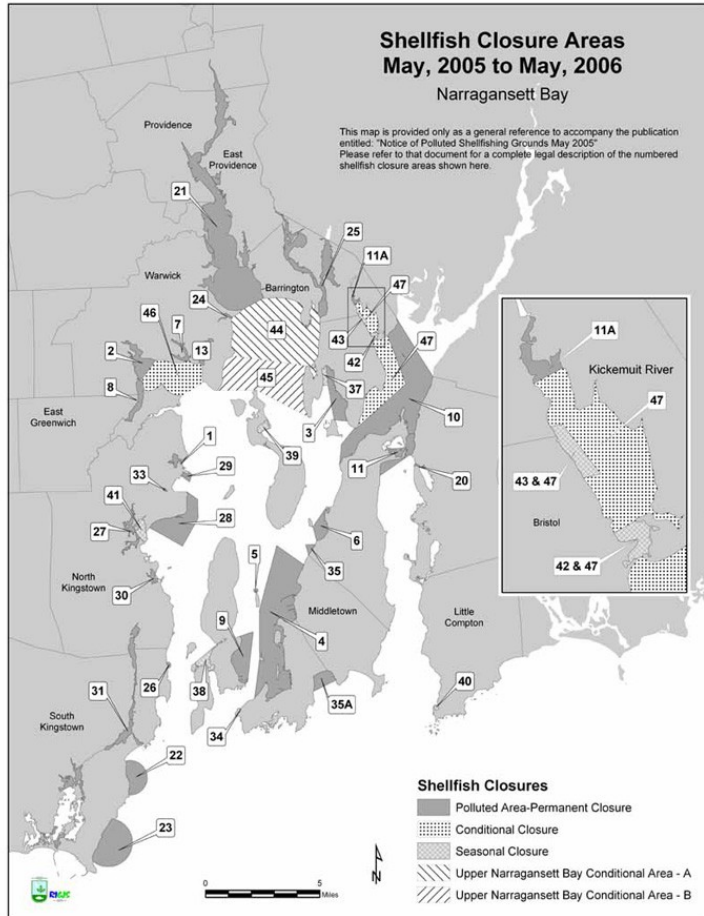


Implementing Sanitary Shoreline Surveys

- Make sure defined survey areas sized to be able to complete survey in about 4 hours
- Conduct baseline survey and record results in spreadsheet
- Update surveys periodically
- Survey data is multipurpose
 - Prioritization for remediation
 - Establishing water quality classification zones



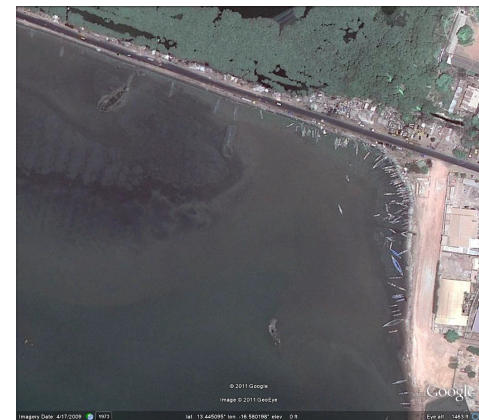
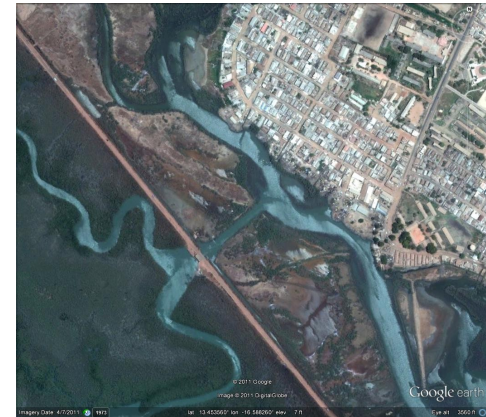
General Criteria for Establishment Water Classification Zones



- Close known areas based on known effluents
- Choose areas with access point for survey & water sampling
- Choose area sizes to aid surveying in short time

General Criteria for Establishment of Shellfishery Closure Areas

- Data from shoreline surveys
 - areas within $\frac{1}{2}$ km of shoreline village
 - areas with concentrated runoff (e.g. Bund Road floodgates)
 - boat landing areas
 - $\frac{1}{2}$ km from areas with animal raising close to water
 - areas near dumpsites
- Rainfall data
 - rainy season blanket closure: season of known highest coliforms



Thank you -- Jere jef -- On jaaraama
Al ning bara -- I ni che



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