



Indicator bacteria: Deer Island disinfection and dilution at outfall protect Mass Bay

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Deer Island: Fecal coliform, 2008-16

Effluent fecal coliform
Daily geometric mean (CFU/100mL)

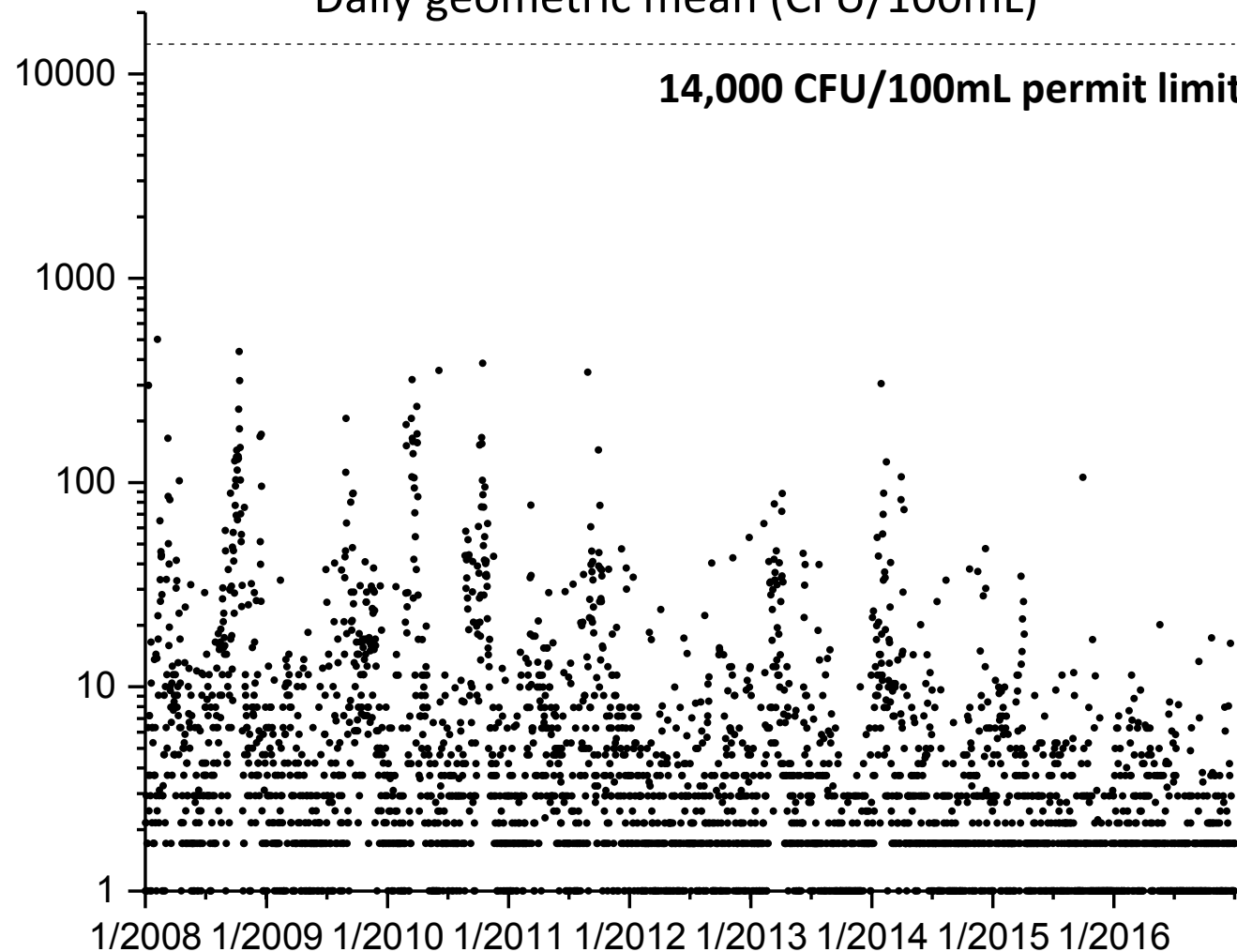
14,000 CFU/100mL permit limit

48% of all tests were
non-detects

99th percentile was
131 CFU/100mL

Maximum was
501 CFU/100mL

No permit violations
2008-16 (only
violations were in
12/2001 and
4/2004)





Deer Island: Potential future *Enterococcus* permit limits

- Current Massachusetts **marine receiving water** *Enterococcus* standards:
 - Geometric mean: 35 col/100mL
 - Single sample: 104 col/100mL

- Potential limits for **effluent**, using 70-fold dilution factor:

<u>Geometric mean</u>	<u>Single sample</u>	
35 col/100mL	104 col/100mL	<i>Current standard</i>
X 70	X 70	<i>Dilution factor</i>
= 2,450 col/100mL	= 7,280 col/100mL	Enterococcus limit

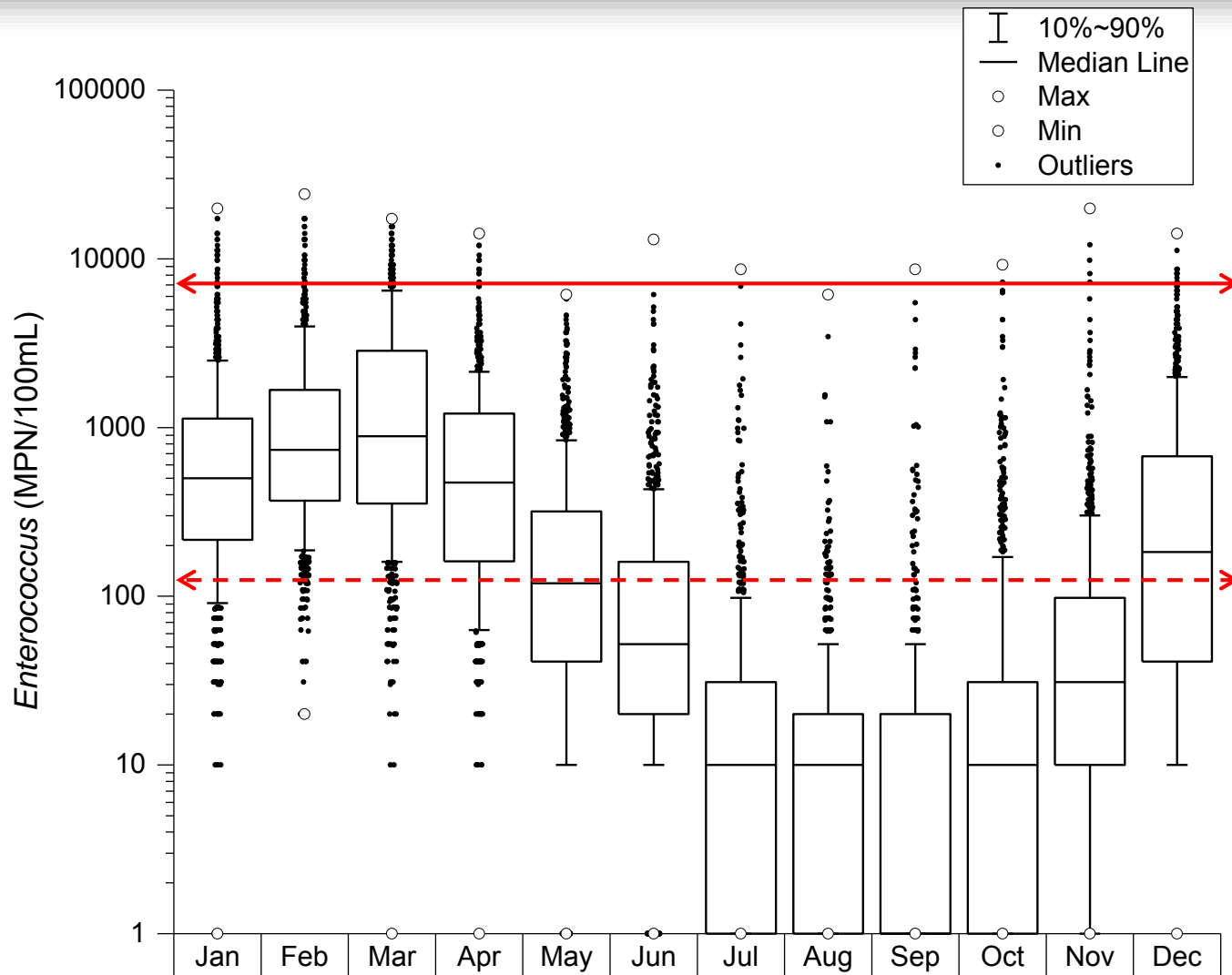


Deer Island: *Enterococcus* by month, 2008-16

Distribution plot of single *Enterococcus* samples from 2008-2016, by month

Strong seasonal pattern:

- high in late winter and early spring
- low in late summer and early fall

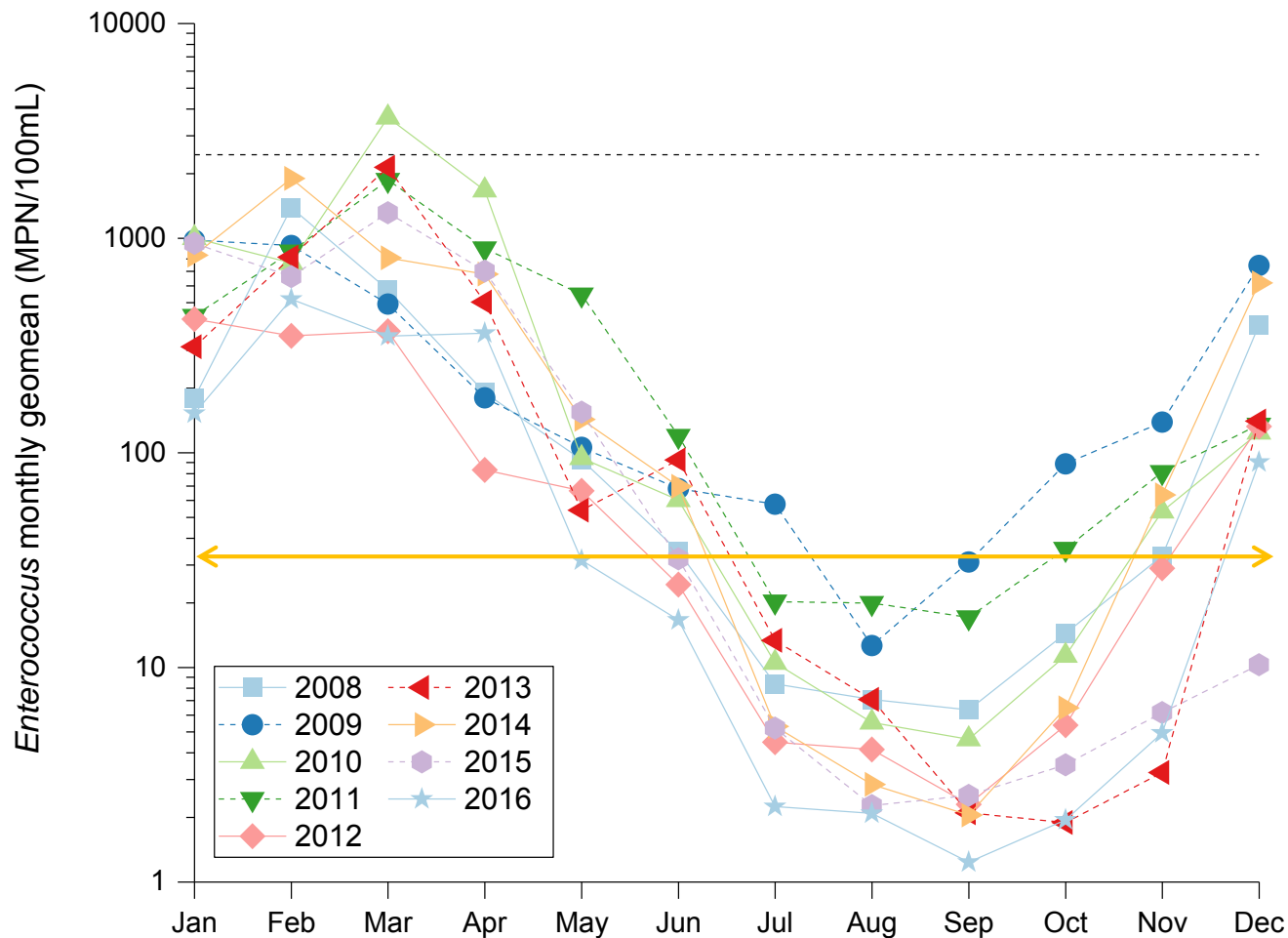




Deer Island: *Enterococcus* by monthly geometric mean, 2008-16

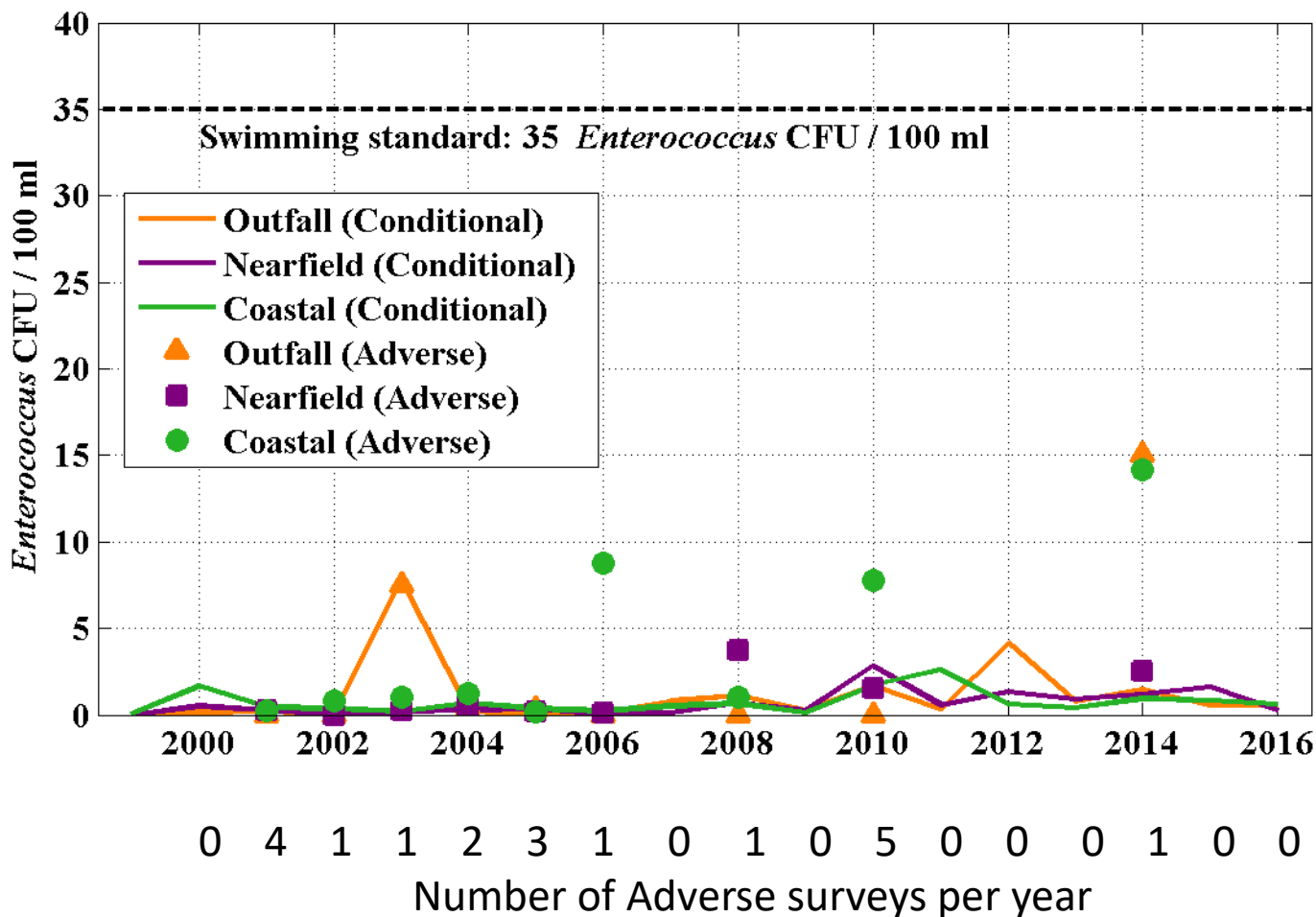
Monthly geometric means, 2008-2016

All years show same seasonal pattern





Mass Bay: *Enterococcus* annual mean results



Similar results to Fecal coliform:

Vast majority (91%) of samples are non-detects

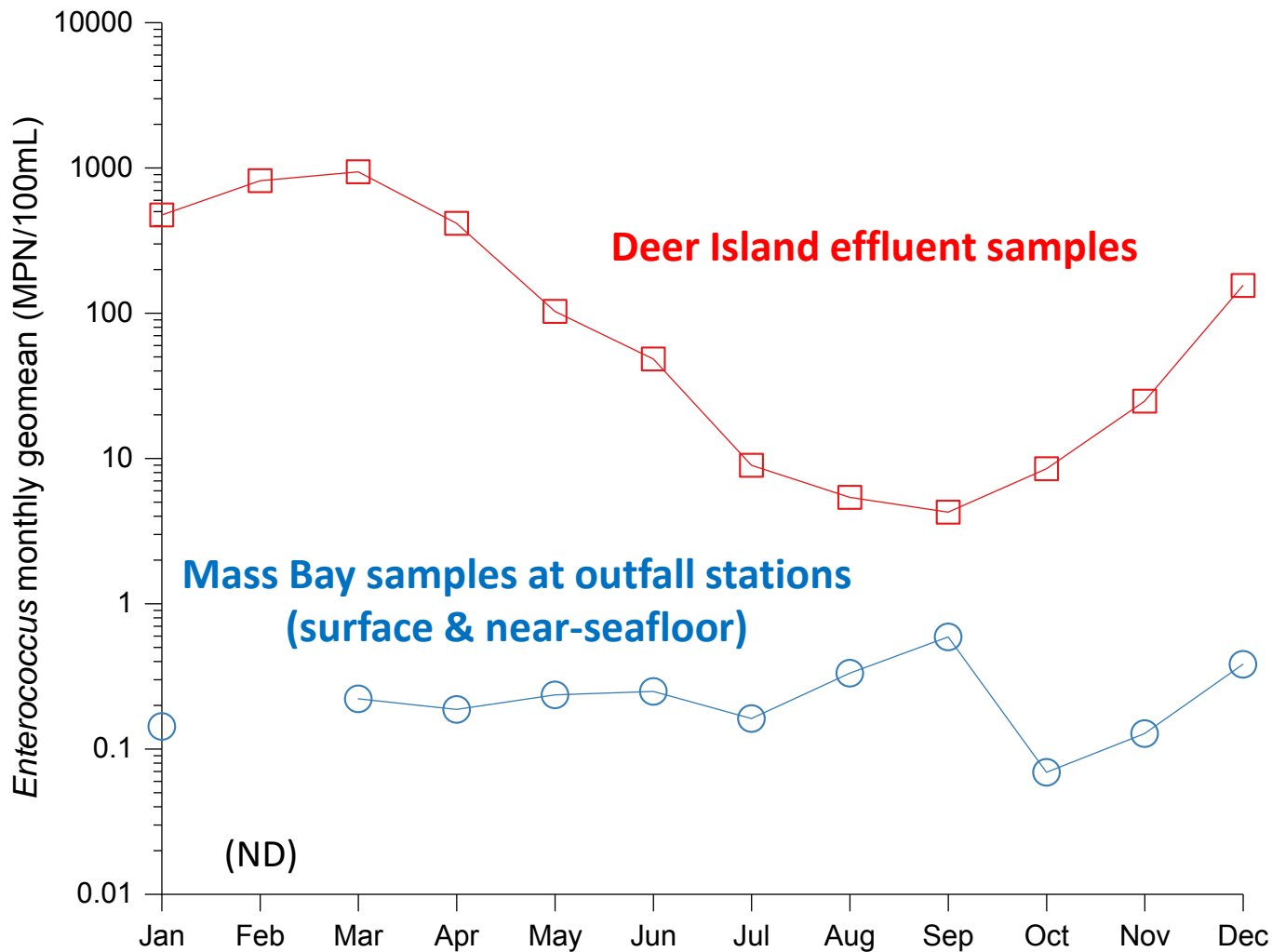
Annual means well below swimming standard

Similar results for outfall, nearfield, and coastal stations

Similar results for Adverse and Conditional surveys



Synthesis: Counts in effluent and receiving waters, 2008-16



Effluent:

- Strongly seasonal
- Peak in late winter

Receiving waters:

- Very low levels
- Vast majority non-detects
- Not seasonal like effluent

ND = Not detected in Feb 2008-2016



Implications: Managing effluent *Enterococcus* levels

- Cannot increase contact time
- Increased chlorination?
- Seasonal limits?





Implications: Side effects of increased chlorination

- Possible increased toxicity
 - Permit requires monthly toxicity tests
- Increased chemical costs
- Increased truck traffic through Winthrop for chemical delivery
 - Higher chance of accidents
 - Increased traffic congestion
 - Higher greenhouse gas emissions
 - Unhappy neighbors



Final conclusions

- Effluent at Deer Island:
 - Fecal coliform: very low and in full compliance
 - *Enterococcus*: not yet regulated, but...
 - Strongly seasonal with high levels in late winter
 - If/when regulated, may require operational changes
- Mass Bay
 - Both fecal coliform and *Enterococcus* levels have met water quality standards very consistently year-round
 - Outfall has very minor influence
- **Potential operational changes would have negative consequences with likely little impact on protection of receiving waters**



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Questions?

