

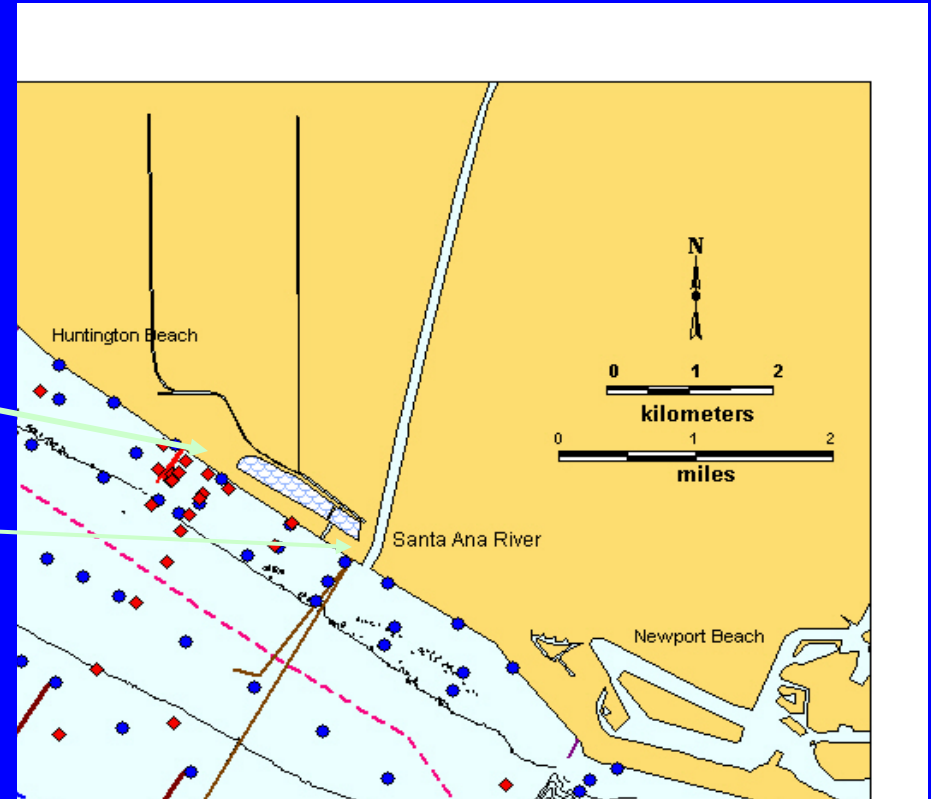
Significant developments since 2002

1. new studies: sources of bacteria (Grant et al)
 - Santa Ana River or Talbert Marsh
 - storm drain at Newport Beach
2. chlorination to kill bacteria in sewage
 - you could swim in outfall plume
 - beach is no cleaner than before

Talbert Marsh
lots of birds

Santa Ana River

- tertiary sewage from upstream
- **storm drain** from Newport Beach
- channel usually dry!!!



Two sources of contamination right at the beach!



**This is where
you “curb”
your dog.**

**In Newport Beach,
it drains into
Santa Ana River.**

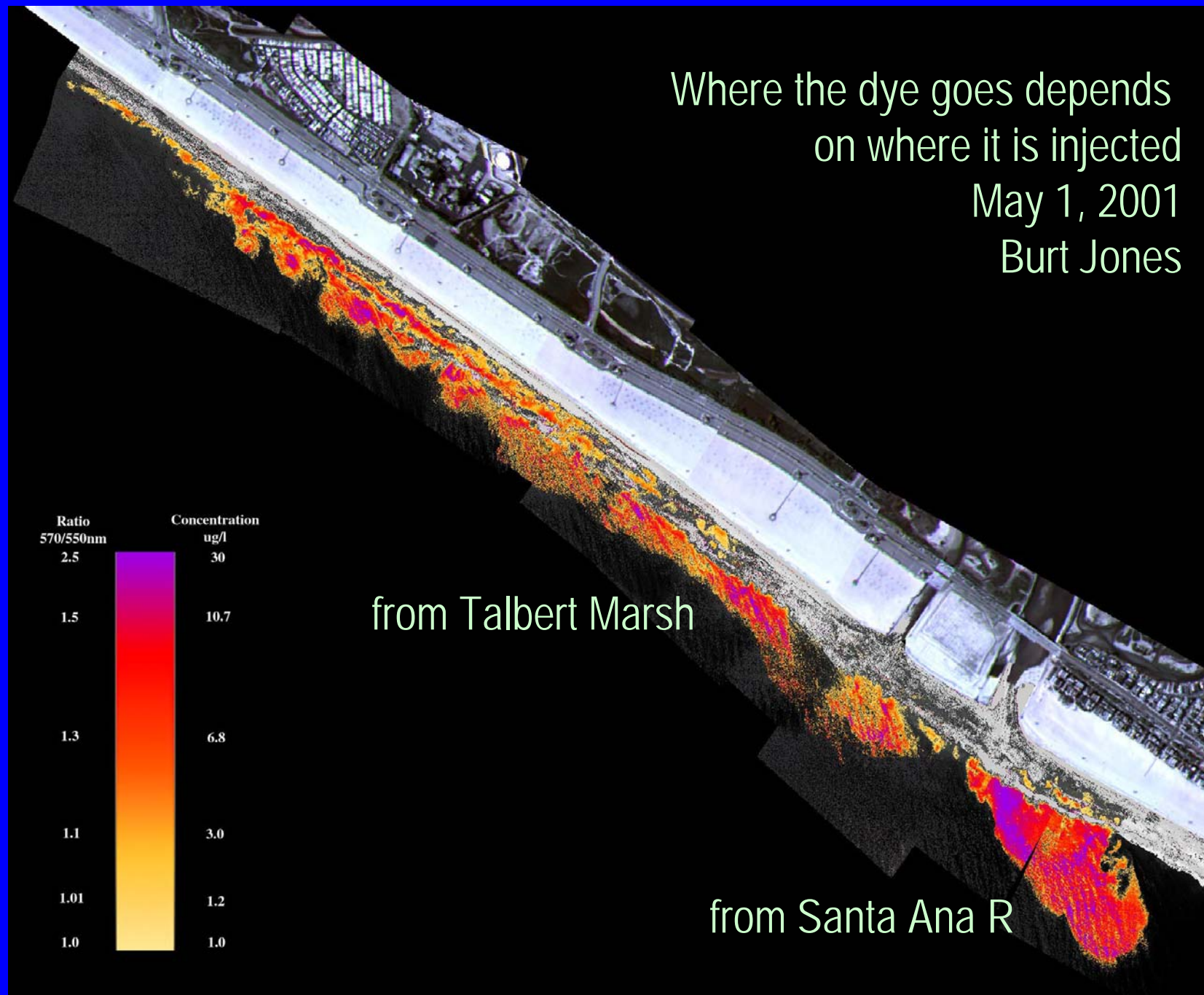
google "fecal coliform"
www.epa.gov

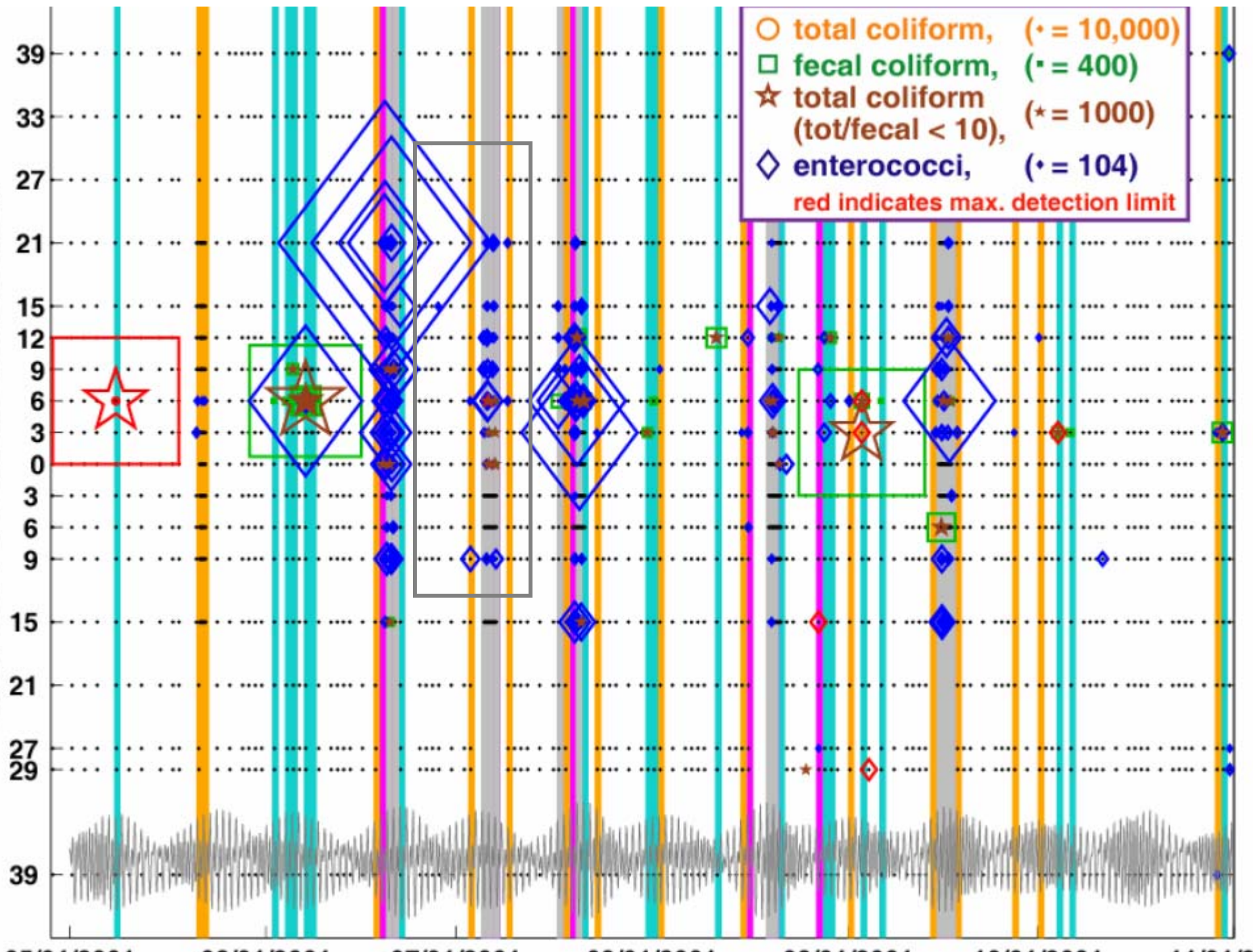


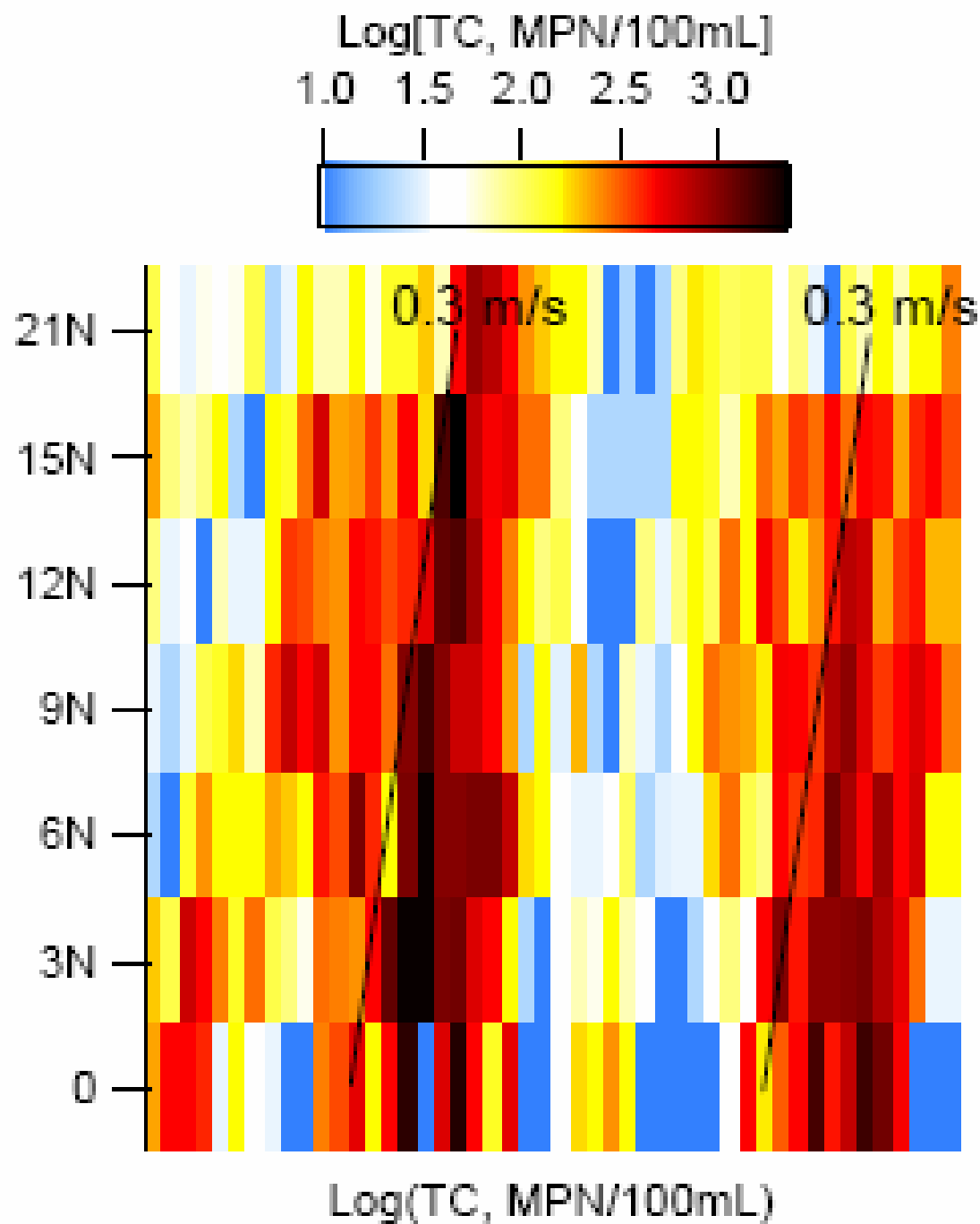


Dye put into Talbot Marsh
spreading west along
Huntington Beach
May 1, 2001
Burt Jones

Where the dye goes depends
on where it is injected
May 1, 2001
Burt Jones





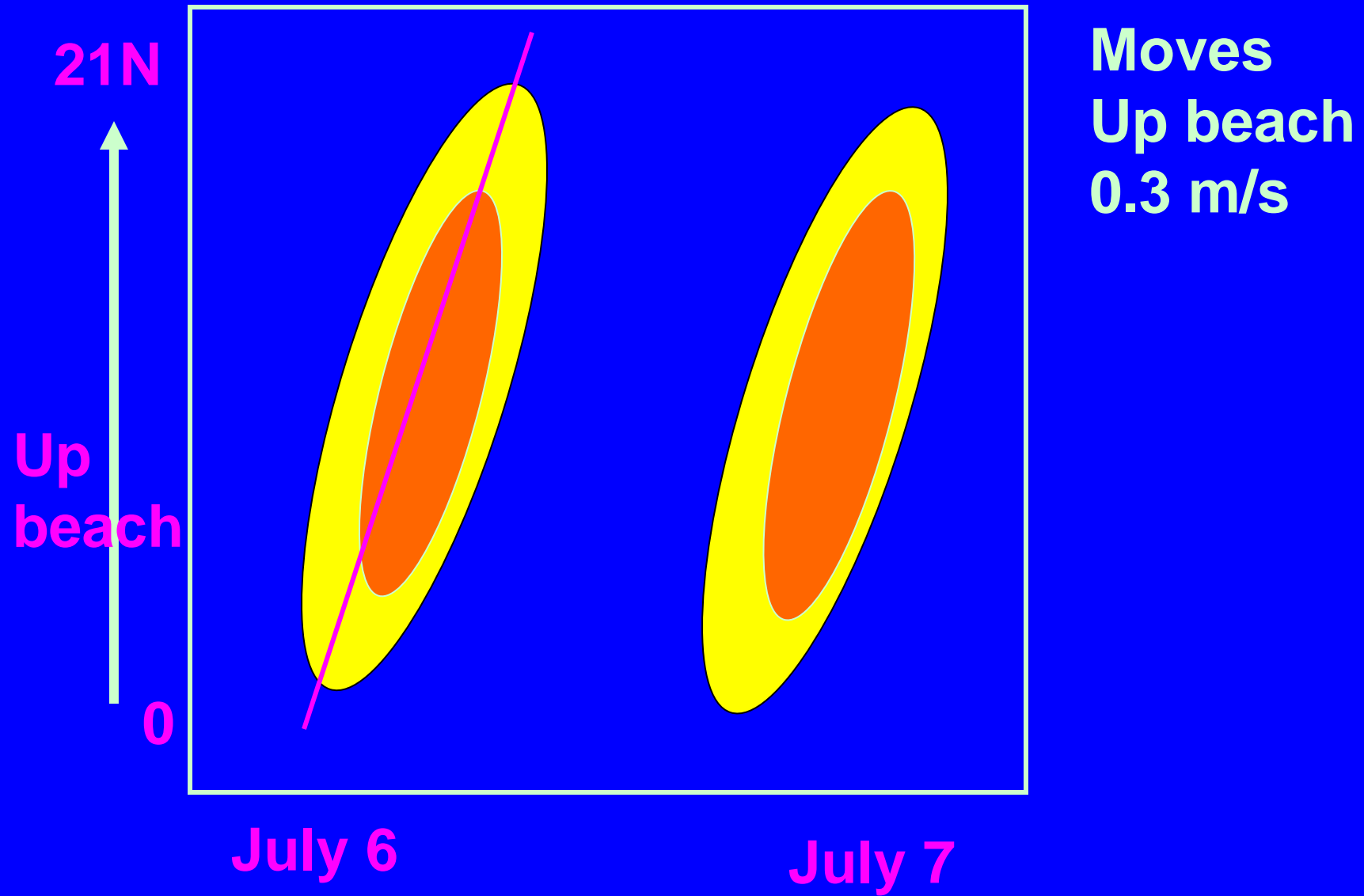


Total Coliform!

2 days in July

Grant et al, 2005

Total Coliform Only



What do you think?

Is the beach contamination likely due to storm drains?
What should be done?

Problem: storm drains are not centrally controlled.
Sometimes no one knows where they are.

Follow up # 2: Chlorination of Sewage

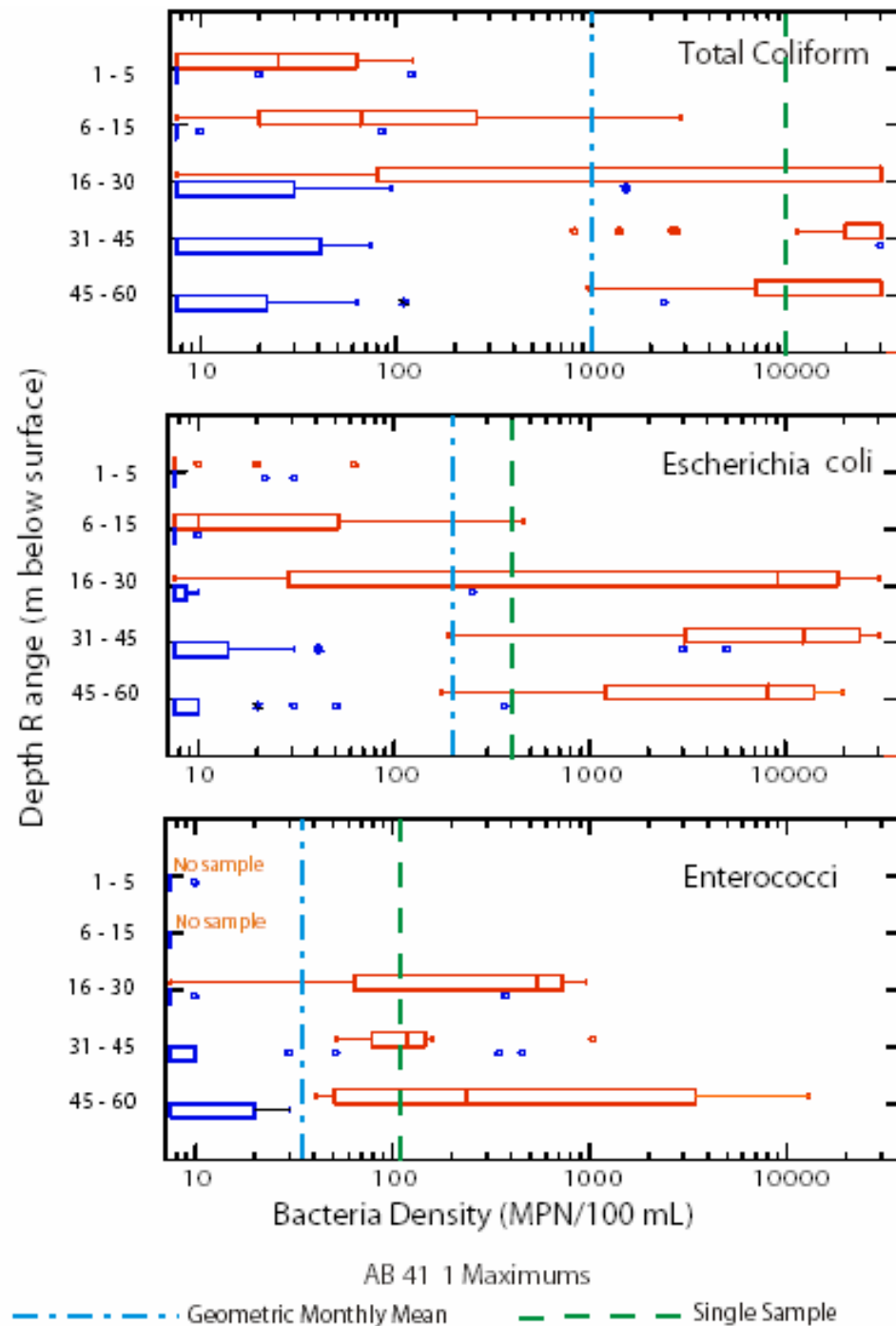
- triple-strength Chlorox– 20,000 gal/day
- kills bacteria; also nasty for other animals
- controversial
- de-chlorination is tricky!
- will it affect beach bacteria?



Effect of chlorination on Huntington Beach

- bacteria in outfall reduced by 99.99 %
- outfall plume never exceeds AB411 standards
- outfall plume 100x cleaner than beach
- beach contaminations still occur

What does this imply about source of contamination?



plume bacteria

reduced by disinfection

old: above AB411 standards

new: below AB411

it's safe to swim in the plume

... but ...

is the beach any cleaner?

Noble et al, 2004

Patterns in beach contamination are essentially unaffected by chlorination

Annual cycle:

lots of bacteria in winter due to local runoff in storms

Fortnightly cycle:

lots of bacteria during spring tides

Why:

- seawater gets into Talbert Marsh and Santa Ana River
- accumulated junk gets washed into ocean

So, is it safe to swim in the ocean or not?

beach report cards for California
www.healthebay.org

beach water quality in North Carolina
<http://www.earth911.org/WaterQuality/default.asp?cluster=8>

annual survey, nationwide
<http://www.beach.com/stateofthebeach2004/home.asp>

Things a concerned citizen must know

- our actions affect the ocean for better or worse
- issues are rarely simple; laws are compromises
- it's tempting, but unwise, to distort facts when morally "right"
- some decisions are made without all the facts available
- science is a process, not pre-determined truth
- peer review means lying kills a scientific career

My personal message to you:

If you want to change the world, do your research carefully.

Extras follow

Chlorine disinfection of sewage: Chlorox Bleach

- add Chlorox to sewage
- kills bacteria
- uses up bleach

Residual Chlorine is nasty

- kills other marine life
- makes your eyes sting
- makes your fingers slippery

De-Chlorination

- does not remove chlorine atoms
- converts ClOH to Cl^-
- Cl^- is chloride, part of salt
- process uses Sulfur Dioxide (SO_2)
- SO_2 stinks of rotten eggs
- need to use exactly the right amount
- very tricky!

which is worse, bacteria, chlorine or sulfur?

Review Questions

General

- what is governed by CA state AB411 standards?
- what are indicator bacteria?
- how are bacteria identified?

Huntington Beach enterococcus and coliform bacteria

- describe spatial and temporal patterns
- beach more or less concentrated than outfall?
- do they appear to come from the same source?
- do contaminations occur during spring or neap tides?

Internal Tides

- what is an internal tide?
- how could an internal tide affect transport of sewage?
- do internal tides appear to cause beach contamination?

Levels of Sewage Treatment

The Clean Water Act [1972] requires publicly owned treatment facilities to upgrade to full secondary treatment before discharging into the ocean.

Primary Treatment –

Physical filters; removes 40% of solids

Secondary Treatment –

Biological treatment + more filters; removes 85% of solids

Tertiary Treatment –

May remove nutrients, toxic chemicals, metals, bacteria

Can use outflow to water food crops

Review Questions

- what is the Federal Clean Water Act (1972)?
- what are effects of primary,
secondary and tertiary treatment?
- how is sewage treatment like running an aquarium?

Dramatis Personae:

Orange County Sanitation District
Environmentalists
Scientists
Concerned Citizens

Some of the Actors:

Blake Anderson, George Robertson
Doug Korthof, Joey Littleshell
Marlene Noble, Stan Grant
cast of thousands

Other possible standards: more stringent than AB-411

Fecal coliform:

0 for drinking

<1000/100 ml for swimming

<5000/100 ml for boating

<http://ccge.cecgeo.org/documents/riverlessons/coliform.htm>

Enterococcus:

<35/100 ml in mainland marine waters

<http://www.volusiahealth.com/lab/FAQS/Default.asp>