RECREATIONAL WATERS
Quality and Surveillance

Acquasur 2004
SUMMARY

1. INTRODUCTION - CONCEPTS
2. BEACH MONITORING IN SÃO PAULO
   METODOLOGY
   RESULTS
3. EPIDEMIOLOGICAL STUDY
Recreational Waters and water quality assessment

• Recreational waters: coastal and fresh waters
• Recreational water uses related to water quality are defined as activities where whole-body contact takes place and there is significant risk of water ingestion.

*Guidelines for safe recreational water environments: vol1 - WHO*
Water quality assessment

- Recreational water quality or safety
- Microbial water quality assessment (numerical information of the actual level of fecal pollution)
- Classification
Water quality assessment

Microbial water quality assessment

Classification

Very good  Fair  Good  Poor  Very poor
Fecal pollution and water quality

• Fecal pollution of recreational water can lead to health problems because of the presence of pathogenic microorganisms.

• The most frequent adverse health outcome associated with exposure to fecally contaminated recreational water is enteric illness.
Disease - Causing Microorganism in sewage

- **Bacteria** - Gastroenteritis
- **Viruses** - Gastroenteritis, respiratory infections, hepatitis
- **Protozoa** - Gastroenteritis, cryptosporidioses and giardasis
- **Helminths** - Digestive disturbances
Causes of beach pollution

The most frequent sources of fecal pollution are:

• sewage overflows
• polluted storm water runoff
• sewage treatment plant malfunctioning
• septic systems malfunctioning
• sea outfalls
SÃO PAULO STATE BEACH MONITORING PROGRAMS

- COASTAL WATERS
  Started in 1974

- FRESHWATER
  Started in 1993
Beach Monitoring in Reservoirs

- **Metropolitan region**
  - 2 major reservoirs:
    - 21 sampling sites

- **Other regions**
  - 6 reservoirs:
    - 10 sampling sites
São Paulo Coastal waters

- 400 Km of beaches
- 290 beaches
- 2.5 million people in the summer
Sampling Methodology

- Sampling sites
- Sampling conditions
- Sampling frequency
Sampling sites

- 15 municipalities
- 148 sampling sites
- 128 beaches
Sampling

- 6 technicians each Sunday
- 600 water samples/month
- approximately 8000 analysis/year
<table>
<thead>
<tr>
<th>Municipality</th>
<th>Number of beaches</th>
<th>Beach Extension (km)</th>
<th>Monitored Extension (km)</th>
<th>Sampling sites</th>
<th>Sampled Beaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ubatuba</td>
<td>78</td>
<td>53</td>
<td>28</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>Caraguatatuba</td>
<td>20</td>
<td>29</td>
<td>28</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Ilhabela</td>
<td>44</td>
<td>14</td>
<td>7,5</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>São Sebastião</td>
<td>42</td>
<td>33</td>
<td>34</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>Bertioga</td>
<td>7</td>
<td>36</td>
<td>30</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Guarujá</td>
<td>20</td>
<td>19</td>
<td>13</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Santos</td>
<td>6</td>
<td>6</td>
<td>5,5</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>São Vicente</td>
<td>5</td>
<td>6</td>
<td>3,5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Praia Grande</td>
<td>10</td>
<td>22</td>
<td>20</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Mongaguá</td>
<td>5</td>
<td>13</td>
<td>12</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Itanhaém</td>
<td>11</td>
<td>22</td>
<td>22</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Peruíbe</td>
<td>18</td>
<td>39</td>
<td>16</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Iguape</td>
<td>6</td>
<td>27</td>
<td>7,5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Ilha Comprida</td>
<td>7</td>
<td>64</td>
<td>7</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cananéia</td>
<td>13</td>
<td>45</td>
<td>7</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cubatão</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>292</strong></td>
<td><strong>428</strong></td>
<td><strong>234</strong></td>
<td><strong>148</strong></td>
<td><strong>128</strong></td>
</tr>
</tbody>
</table>
Microbiological Indicators

• Faecal Coliforms
• Escherichia coli - Reservoirs
• Enterococci - Marine waters
Federal Legislation:
Resolução do CONAMA 274/00

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>Fecal coliforms (NMP/100mL)</th>
<th>Escherichia coli (UFC/100mL)</th>
<th>Enterococci (UFC/100mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROPER</td>
<td>&lt;250 in at least 80% of the samples</td>
<td>&lt; 200 in at least 80% of the samples</td>
<td>&lt; 25 in at least 80% of the samples</td>
</tr>
<tr>
<td>GOOD</td>
<td>&lt;500 in at least 80% of the samples</td>
<td>&lt; 400 in at least 80% of the samples</td>
<td>&lt; 50 in at least 80% of the samples</td>
</tr>
<tr>
<td>FAIR</td>
<td>&lt;1000 in at least 80% of the samples</td>
<td>&lt; 800 in at least 80% of the samples</td>
<td>&lt; 100 in at least 80% of the samples</td>
</tr>
<tr>
<td>IMPROPER</td>
<td>&gt; 1000 in more of 20%</td>
<td>&gt; 800 in more of 20%</td>
<td>&gt; 100 in more of 20%</td>
</tr>
<tr>
<td></td>
<td>&gt; 2500 in the last sample</td>
<td>&gt; 2000 in the last sample</td>
<td>&gt; 400 in the last sample</td>
</tr>
</tbody>
</table>
Other non-compliance conditions

- Oil Spills
- Algal Blooms
Important features

• Fecal pollution sources
• Rainfall
• currents
• tides
• beach physiography
Sampling sites selection

- Bathers
- Urban occupation
- sanitary conditions
Sampling conditions

• **site:** Depth = 1m
  
  not close to potential sewage discharge

• **Conditions:** the critical situation

• **Frequency:** weekly (on Sundays)

  three times a week (summer)
Brazilian monitoring

Northeast States
- Ceará
- Pernambuco
- Paraíba
- Bahia

South and Southeastern States
- Espírito Santo
- Rio de Janeiro
- São Paulo
- Paraná
- Santa Catarina
- Rio Grande do Sul
Evolution of beach quality over the year

Number of non complying beaches

Número de Praias Impróprias

Evolution of beach quality over the year

Boletins-Jan/Fev/Mar
## Annual Qualification

<table>
<thead>
<tr>
<th>Annual Qualification</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very Good</strong></td>
<td>Excelent 100% of the year</td>
</tr>
<tr>
<td><strong>Good</strong></td>
<td>100% of compliance</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Non-compliance under 50% of the year</td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>Non-compliance over 50%</td>
</tr>
<tr>
<td>MUNICÍPIO</td>
<td>ANO</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Praia</td>
<td>91</td>
</tr>
<tr>
<td>São Sebastião</td>
<td></td>
</tr>
<tr>
<td>Prainha</td>
<td></td>
</tr>
<tr>
<td>Cigarras</td>
<td></td>
</tr>
<tr>
<td>São Francisco</td>
<td></td>
</tr>
<tr>
<td>Arrastão</td>
<td></td>
</tr>
<tr>
<td>Pontal da Cruz</td>
<td></td>
</tr>
<tr>
<td>Porto Grande</td>
<td></td>
</tr>
<tr>
<td>Preta do Norte</td>
<td></td>
</tr>
<tr>
<td>Grande</td>
<td></td>
</tr>
<tr>
<td>Barequeçaba</td>
<td></td>
</tr>
<tr>
<td>Guaecá</td>
<td></td>
</tr>
<tr>
<td>Toque-Toque Grande</td>
<td></td>
</tr>
<tr>
<td>Toque-Toque Pequeno</td>
<td></td>
</tr>
<tr>
<td>Santiago</td>
<td></td>
</tr>
<tr>
<td>Paúba</td>
<td></td>
</tr>
<tr>
<td>Maresias</td>
<td></td>
</tr>
<tr>
<td>Boiçucanga</td>
<td></td>
</tr>
<tr>
<td>Camburi</td>
<td></td>
</tr>
<tr>
<td>Baleia</td>
<td></td>
</tr>
<tr>
<td>Saí</td>
<td></td>
</tr>
<tr>
<td>Preta</td>
<td></td>
</tr>
<tr>
<td>Juqueí - Trav. Simão Faustino</td>
<td></td>
</tr>
<tr>
<td>Juqueí - R. Cristiana</td>
<td></td>
</tr>
<tr>
<td>Una</td>
<td></td>
</tr>
<tr>
<td>Engenho</td>
<td></td>
</tr>
<tr>
<td>Juréia do Norte</td>
<td></td>
</tr>
<tr>
<td>Boracéia</td>
<td></td>
</tr>
</tbody>
</table>
Beach quality - State of São Paulo 2003

- Very Good: 45%
- Good: 26%
- Moderate: 15%
- Poor: 7%
- Sist. Good: 7%
Water bodies Monitoring

• Approximately 600 sampling sites
• twice a year
• microbiological analysis
Water bodies quality
2003

Fecal Coliformes

<table>
<thead>
<tr>
<th>Category</th>
<th>% of water bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;103</td>
<td>25%</td>
</tr>
<tr>
<td>10^3</td>
<td>19%</td>
</tr>
<tr>
<td>10^4</td>
<td>28%</td>
</tr>
<tr>
<td>10^5</td>
<td>23%</td>
</tr>
<tr>
<td>&gt;=10^6</td>
<td>5%</td>
</tr>
</tbody>
</table>
Communication

1. Beach Flags
2. Weekly bulletins
3. Internet: www.cetesb.sp.gov.br
4. Phone 0800-113560
5. Annual Reports
Epidemiological Study

- 5 beaches of São Paulo Coast
- January and February 1999
- Beach interviews
- water quality assessment
  3 locations - 4 microbiological indicators
Epidemiological Study
Objectives

- To know the profile of São Paulo beaches tourist
- To Verify a the correlation between the occurrence of gastrointestinal symptoms in bathers and the different levels of water microbiological indicators
- To develop a scientific background for standard definitions
Results

Beach Interviews:
6,342 families
Total: 23,235 people

📞 Phone Calls:
Total: 16,637 people = 72%
2,162 people = 13%
related at least 1 of the symptoms
Bathers with symptoms X Degree of Exposure

(X 1000)

Beaches

A B C D E

Não Exposto

Exposto

Altamente Exposto

0 20 40 60 80 100 120 140 160

Altamente Exposto

Exposto

Não Exposto
Bathers with symptoms X age group

(X1000)

Beaches

Até 7 anos
8 a 19 anos
20 ou mais
Conclusions

• Children under 7 presented more symptoms
• Exposure level to sea water was correlated to symptom occurrence
• Beaches with higher non-compliance levels presented more bathers with symptoms
• Enterococci showed better correlation to health effects
Companhia de Tecnologia de Saneamento Ambiental

Claudia Condé Lamparelli
claudial@cetesb.sp.gov.br