Guanabara Bay

- 2B m^3 of water. 384km^2. 55 rivers contribute an average annual flow of 350m^3/s

(Portuguese: *Baía de Guanabara*, IPA: [gwanaˈbaɾɐ]) is an oceanic bay located in Southeast Brazil in the state of Rio de Janeiro. On its western shore lies the city of Rio de Janeiro and Duque de Caxias, and on its eastern shore the cities of Niterói and São Gonçalo. Four other municipalities surround the bay's shores. Guanabara Bay is the second largest bay in area in Brazil (after the All Saints' Bay), at 412 square kilometres (159 sq mi), with a perimeter of 143 kilometres (89 mi).

Guanabara Bay is 31 kilometres (19 mi) long and 28 kilometres (17 mi) wide at its maximum. Its 1.5 kilometres (0.93 mi) wide mouth is flanked at the eastern tip by the Pico do Papagaio (Parrot's Peak) and the western tip by Pão de Açúcar (Sugar Loaf).

There have been three major oil spills in Guanabara Bay. The most recent was in 2000 when a leaking underwater pipeline released 1,300,000 litres (340,000 US gal) of oil into the bay, destroying large swaths of the mangrove ecosystem. Recovery measures are currently being attempted, but more than a decade after the incident, the mangrove areas have not returned to life.

Max. length	31 km (19 mi)
Max. width	28 km (17 mi)
Surface area	412 km^2 (159 sq mi)

The bay has a mean 1.0 tidal range and exhibits a mixed , mainly semidiurnal period.

The area weighted depth is 5.7m and the maximum depth is 58 m.

Guanabara bay has a total water volume of $1.87x10^9$ $m^{3.}$

The bay has a narrow 1,6 km ocean entrance to the south, where a 2km wide channel stretches 20 km into the bay . The water depth is on average less than 3m in the inner bay

The present study aimed to evaluate the water quality of the Icaraí Sewage Outfall (ISEO) area. Sampling was conducted during winter and summer, and water samples were analyzed for dissolved oxygen, pH, temperature, salinity, dissolved inorganic nutrients (DIN), seston, particulate organic matter (POM), and pigments. Results showed that the water chemistry of the area suffers temporal and spatial variation. Great variability was also seen in the C:N:P ratios of POM (August, 112:30:1; December, 59:11:1) and in the DIN concentrations. Chlorophyll-a and ammonium concentrations (4.5 µg L^{-1} - 71.2 µg L^{-1}, and 0.20 µM - 52,6 µM, respectively) characterized the ISEO area as eutrophic. The dispersal of the material was not effective under certain oceanographic conditions.

Depth of the water GB.

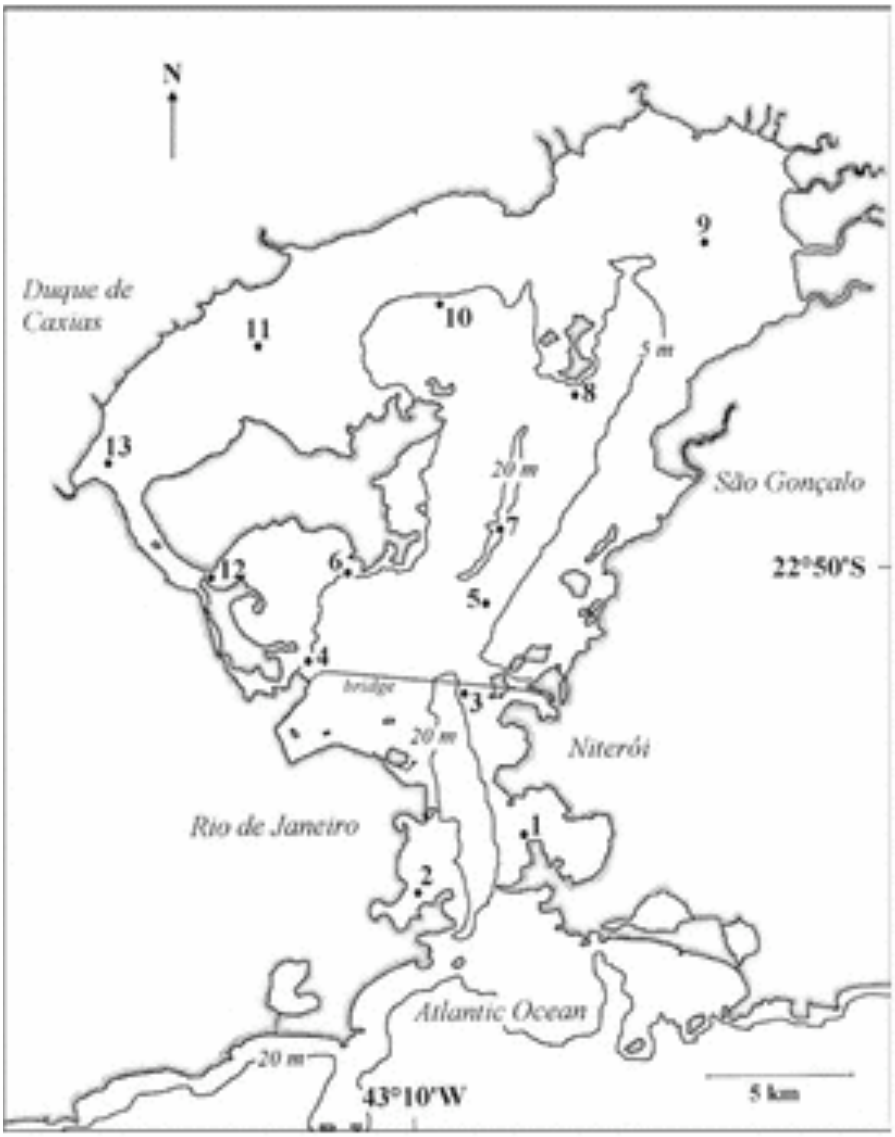

Fig. 1
Guanabara Bay map showing the FEEMA sampling locations and 5- and 20-m-depth contours. The 13-km-long, six-lane-wide Rio de Janeiro–Niterói highway bridge crosses the southern bay but allows ocean-going vessels to pass below

When it bid to host the Games, Rio said it would cut the amount of raw sewage flowing into the bay by 80 percent but has since admitted that is unlikely.

While officials have promised a substantial clean-up in advance of the Games, efforts are being hampered by a lack of available boats to do the job “due to delays in agreeing a contract to purchase them,”

The Rio state government recently withdrew so-called eco-boats that were dredging some of the worst rubbish from the waters.

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Biologists last year said rivers leading into the bay contained a superbacteria that is resistant to antibiotics and can cause urinary, gastrointestinal and pulmonary infections.

An estimated 70 percent of untreated sewage from Rio, including its surrounding municipalities and favelas, flows into the Guanabara Bay. In December, scientists in Brazil announced they discovered a drug-resistant “superbacteria” in the waters that causes gastrointestinal infections.

Fecal coliform counts in these inner reaches of the Bay are 4–100 times higher than the maximum acceptable count for recreational waters.

Rio de Janeiro can't clean up Guanabara Bay in time for its use as the sailing and windsurfing venue for the 2016 Olympic Games, competitors could confront some unaccustomed challenges: millions of dead fish, sewage,"floating sofas, plastic bags and even dead animals" and a deadly "super bacteria." With the games only 17 months away, athletes are concerned and disappointed.

Sediment toxicity assessment of Guanabara2009 Pdf

Despite its high environmental and socio-economic value, GB has not yet been fully studied, and the ecosystem function is still poorly understood. This study showed that the sediment quality of the bay is low, because sediments are toxic. The GB sediments are mainly chronically toxic, but acutely toxic ones also occur. The NW of the bay exhibits the worse conditions. Moreover, it was evidenced the ammonia concentration in GB sediments may vary from rainy to dry seasons, influencing on the toxicity and playing an additional role on the interactions between the mixture of contaminants and the biota. These results suggest that GB in under significant environmental risk, probably due to human activities undertaken in the vicinity which result in chemical contamination and eutrophication. The evidenced toxicity possibly appears to be related to the different contamination sources, which are located in the different GB areas, to the past oil spills, which released large amounts of pollutants in the bay, and to the GB hydrodynamics.
This explains why GB legally protected areas present signals of environmental degradation, as chronic toxicity

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The GB sediments present also potential to affect water column, once elutriates were toxic. Thus, natural or anthropic actions that suspend sediments may produce negative effects to the aquatic biota. Thus, dredging operations should be carefully planned in order to minimize environmental impacts.

There is a need to establish connections or causal relationship between contamination, geochemistry, toxicity and benthic community structure, and to determine if sediments are working as a sink and/or source of contamination. Further investigations would be helpful to the GB management, including corrective, control and prevention actions.

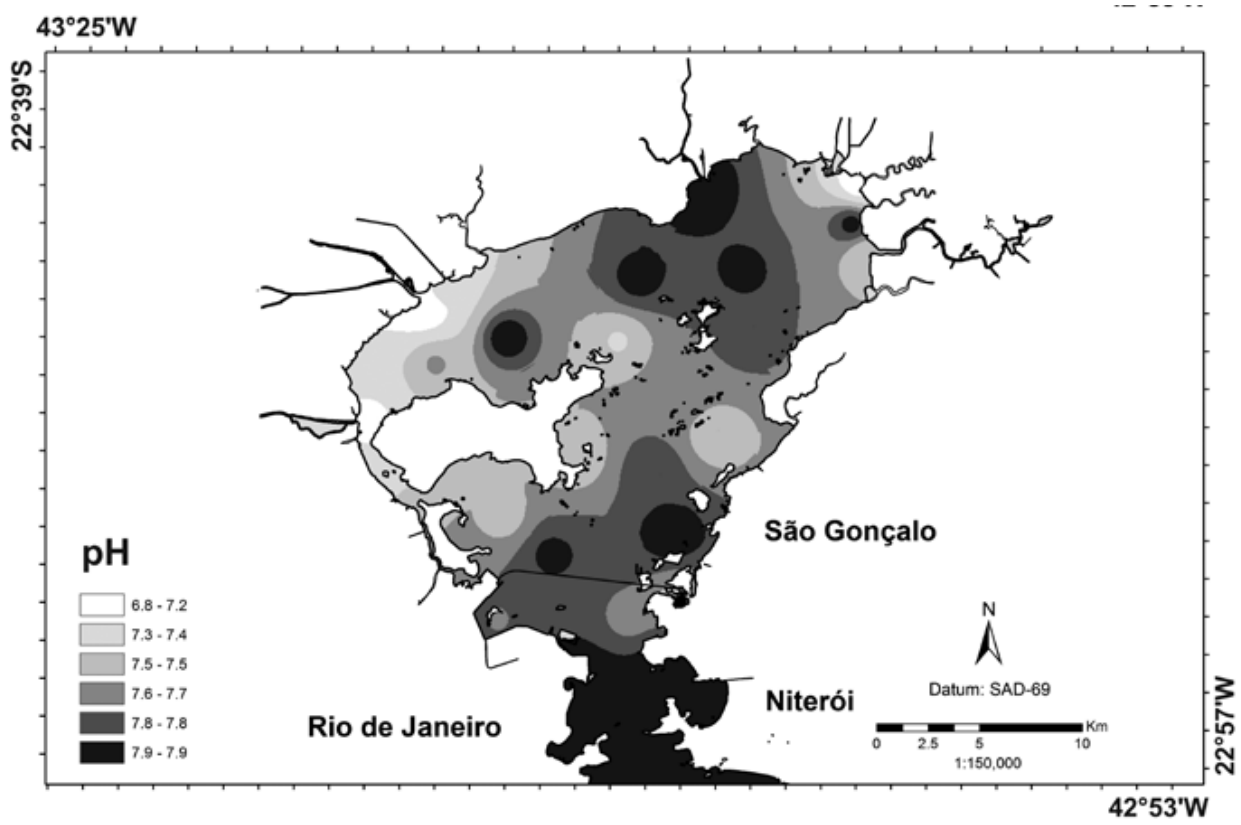
http://sports.yahoo.com/news/water-wont-clean-sailing-ahead-mayor-132114455--oly.html

"I think it is a lost opportunity, yes," Eduardo Paes told Sportv in an interview. "Not for the Olympics but for Rio, it's important to Rio. De-polluting the Guanabara Bay is something we should have done.
"It's a shame that the Olympics were not the reason or the motive, as in Sydney, to resolve the issue once and for all."
However, Paes said he did not believe the dirty waters would pose a risk for sailors.
The sailing events will take place in a relatively clean part of the bay and. As it is the dry season, there will be less water flowing into the bay from the five rivers that surround it, he said.
In addition, staff will be employed to keep flotsam and jetsam away from the boats.

http://www.anuario.igeo.ufrj.br/2011_1/2011_1_64_87.pdf

A strong stratification of dissolved oxygen is observed in areas where depths are under 10 m. Surface oxygen values reach 300% oversaturation in the photic zone (< 5 m), while bottom (4-5 m) concentrations may stay below 1 ml/l (Rebello et al., 1990).
Approximately 11 million inhabitants live in the Greater Rio de Janeiro metropolitan area and, as a result of rapid urbanization and population growth, untreated sewage is discharged directly into the bay

This area is the second largest industrial region in Brazil and has over 12,000 industries operating along the Guanabara Bay drainage basin, and these account for 25% of the organic pollution released into the bay.
The temperature, salinity and pH values ranged from 23.0 - 25.0 °C, 10.0 - 36.0, and 6.68- 7.85, respectively. The means were 23°C, 30 and 7.48, respectively. The highest temperature values were found at the river mouths and in the northwestern bay. Salinity and pH were highest in the central channel
The Guanabara Bay water quality could be returned to pre-1950 conditions, but it would require sufficient political will and economic investment to ensure that at least 80–90% of the domestic and industrial sewage were treated adequately.



P12 The sand sediment occurs in the mouth of bay and follows the main channel, which constitutes the deepest part of the bay. This area is subject to intense hydrodynamic action from waves and tidal currents, indicated by the presence of sand waves (Catanzaro et al., 2004). According to Quaresma et al. (2000) and Kjerfve et al. (1997), these sand waves occur along the eastern margin of the central channel between the 10 and 6 m isobaths. These sand waves attain heights of 0.5-2.5 m, lengths of 18-98 m, and decrease in both height and wavelength from the ocean into the bay in response to decreasing tidal energy. The sand waves have steeper slopes facing the bay, indicating wave progression and bottom sand transport into Guanabara Bay. The north and center areas of the bay are also characterized by the presence of muddy sediments. In the bay's innermost region, in the north of Governador Island (NW), predominance of clay-silts is seen, a coarser sedimentation than in the NE side in the same region. This probably occurs because rivers providing input to this area are strongly impacted by human activity, which indicates significant population density in the region. On the other hand, in the NE bay muddy sediments clays predominate. Such sedimentation can be explained as a product of the combination of lower hydrodynamics with the presence of mangrove vegetation, which acts as a trap, which allows only the finest sediment to pass into the bay. TOC results obtained were similar to those from the literature. Baptista-Neto et al. (2000) found 3-5% variation in total organic carbon for Jurujuba Inlet, Guanabara Bay. The authors justified these values by the restricted entrance of water and the high levels of domestic effluents. The lowest levels were found in higher energy environments, at the Cachoeira River mouth and the southernmost part of the inlet. Carreira et al. (2001), looking for an indicator of recent pollution for domestic sewage in the bay, sampled 8 stations and found TOC values of 2.83–5.54 %. The highest value was found more at northeast, near the mangrove forests, indicating high contamination levels. This region is characterized by water input from a great number of contaminated rivers and by the low water renewal rate. Eichler et al. (2003) found similar values when they collected samples in winter and summer in Guanabara Bay, obtaining values ranging from 0.018 to 5.763% in winter and 0.243 to 6.023% in the summer. Vilela et al. (2003) found TOC values of 0.04–4.14 % (bay mouth); 1.9 –

3.89% (central channel); 0.31– 6.13 % (Rio de Janeiro harbor); 3.23–4.2 % (Niterói harbor); 3.7-4 % (Guapimirim APA) and 3.09–4.81 % (REDUC). Vilela et al. (2003) concluded that the high TOC values in some samples can be accounted for by the proximity to oil refinery pipelines and industrial and domestic sewage discharges. In the central area, TOC values increased as depth decreased, close to the coasts of Rio and Niterói.

It is important to point out that harbor regions such as Guanabara Bay, where ships from all over the world dock, may be contaminated with exotic species through ballast water discharge. Thus, cataloguing and understanding species distribution along the bay becomes needed, as an aid in the elaboration of environmental management plans to minimize possible impacts.

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http://www.researchgate.net/publication/222303705_Oceanographic_characteristics_of_an_impacted_coastal_bay_Baa_de_Guanabara_Rio_de_Janeiro_Brazil._Cont_Shelf_Res

Cannot download but very informative

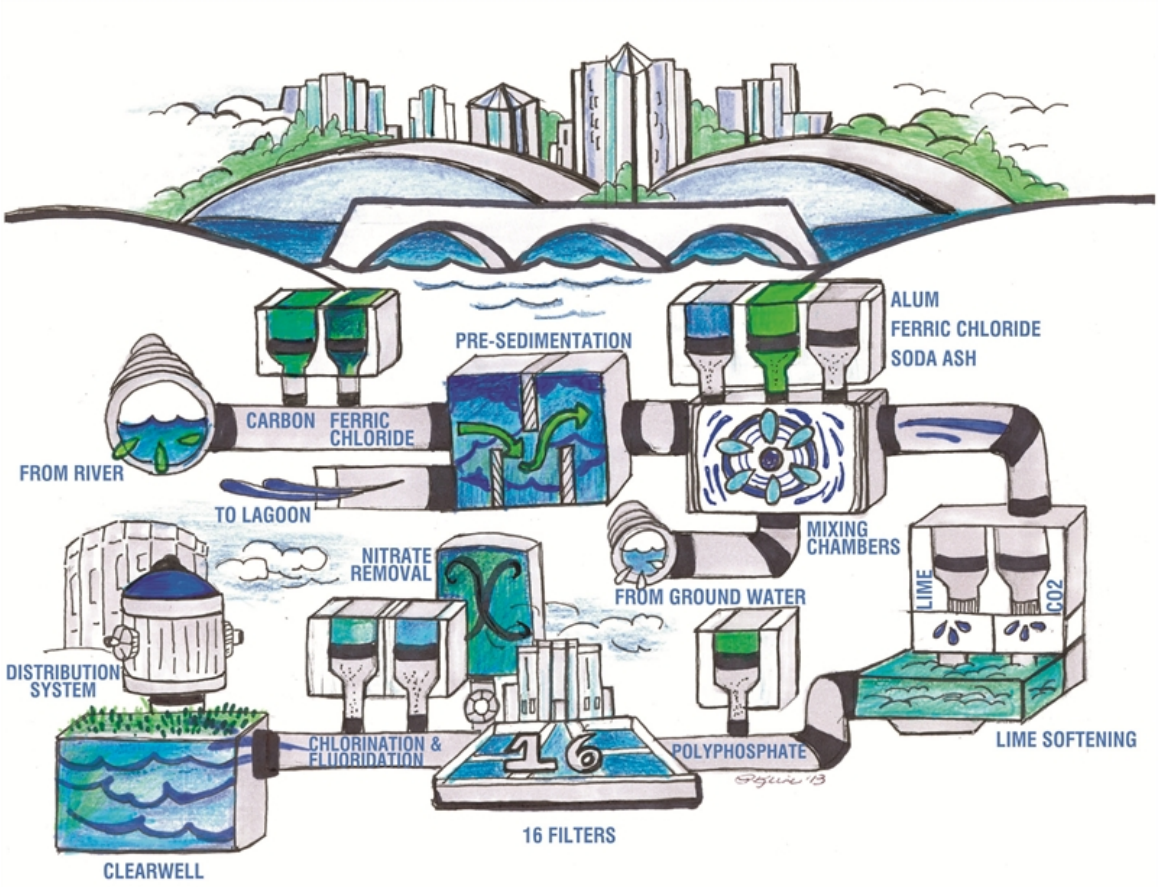
Spatial analysis of lead, copper and zinc contamination in water and sediment on the surroundings of Fundão Island, in Guanabara Bay, Rio de Janeiro, Brazil with the support of geoprocessing and IDW interpolation

http://icaci.org/files/documents/ICC_proceedings/ICC2015/papers/4/849.html

The Guanabara Bay suffers a big environmental degradation, specially on the west side of the hydrographic region. The sewage treatment provided by the bays which contribute to the Guanabara bay

have been insufficient and inefficient. Throughout the history of Rio de Janeiro, the west hydrographic part of the Guanabara bay has a big industry and low income workers concentration. The substantial raise didn't result on the social development, on the contrary, aggravated the environmental and social problems that existed there. This study has as its objective evaluate the spatial distribution from the heavy metal pollution (Pb, Cu and Zn) on the Fundão Island, Guanabara bay surroundings, through maps, monitoring data and bibliography. For this operation the maps were generated through monitoring data.

The used geostatistical interpolation method was the Inverse Distance Weighting (IDW) with the results obtained from the heavy metals concentration analyzed by mass spectometry as basis, this data was provided by the Enviromental State Institute (Instituto Estadual do Meio Ambiente, INEA). Thirteen monitoring points were chosen, in which they presented the complete series history of the heavy metals between the years of 2000 to 2011. Furthermore, in this operation the heavy metals (Pb, Cu and Zn) were evaluated in water and in sediment to verify the concentration contrasts and its distribution in space. The Heavy metal behavior studied was different during the rainy and dry season. The maps showed a higher Lead concentration in water on the rainy season; the Copper presented the higher concentration in water on the dry season and the biggest Zinc concentration was found on sediment. Some of the parameters taken in consideration were: pH, heavy metal type and concentration, thin conglomerate, contact time, vertical and lateral hydrous gradient. Chemical parameters such as: saltiness, temperature and dissolved oxygen concentration, which help the remobilization process between the metal and the components in sediment.


ALUM
FERRIC CHLORIDE
SODA ASH
PRE-SEDIMENTATION
CARBON
FERRIC CHLORIDE
FROM RIVER
TO LAGOON
MIXING CHAMBERS
NITRATE REMOVAL
FROM GROUND WATER
LIME
CO2
DISTRIBUTION SYSTEM
CHLORINATION & FLUORIDATION
16
POLYPHOSPHATE
LIME SOFTENING
16 FILTERS
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