



Stakeholders perceptions of local environmental changes as a tool for impact assessment in coastal zones



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ABSTRACT

Through history, population growth and anthropic activities have pressed and affected marine environments, causing impacts that were not always studied or reported. In this context, evaluate stakeholders perceptions of a particular region in Coastal Zones (CZs) can be useful for identifying environmental impacts that occurred in the past, especially in the absence of preterit data and effective monitoring. Engaging stakeholders in the discussion of local transformations may also contribute to the development of shared local management strategies regarding the knowledge and opinions of stakeholders about the place they live in. Thus, considering Araçá Bay as a case of study, this research aimed to understand preterit and present transformations on the Bay, through the perception of the people who live and visit the region for a long period of time. Data collected with interviews enabled the identification of events and factors that have induced changes in the region, mainly related to large enterprises and buildings that occurred from the second half of the twentieth century. Major impacts perceived by interviewees were changes in spatial configuration of the Bay, changes in hydrodynamic and sedimentary patterns, reduction of coastal vegetation areas and increased pollution. Some of these changes were also pointed by scientific studies or observed in historic aerial photographs, and were not totally predicted by EIA of related enterprise. Considering the importance of communities' perception and its use to better understand historical facts, preterit and present impacts derived from local human interventions, it is concluded that they are an important qualitative database and can be useful for the development of management strategies and for EIA analysis.

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1. Introduction

Coastal Zones (CZs) are dynamic regions, located in the transition between continents and oceans that occupy about 12% of the terrestrial surface (Crossland and Baird, 2005). These areas have high primary productivity and support wide variety of ecosystems, such as beaches, mangroves, salt marshes and coral reefs (Westmacott, 2001; Martins et al., 2012), which provide food, protection and habitat for numerous species (Bijlsma et al., 1995; Burke et al., 2001). In addition to their high ecological value, they also have great social and economic relevance (Martínez et al., 2007) and their goods and services generate fundamental benefits to human life (Turner et al., 1998; Burke et al., 2001; Crossland and Baird, 2005; Beaumont et al., 2008).

However, currently there are no marine areas untouched by human action and CZs are the regions of higher pressure (Halpern et al., 2008). The intensification and diversification of human uses on these spaces have induced changes on marine life, habitats and landscapes (Crossland and Baird, 2005; Cicin-Sain and Belfiore, 2005; Atkins et al., 2011; Martins et al., 2012.). These impacts, in turn, alter the ability of marine environments to sustain human “well-being” providing livelihood, leisure and recreation opportunities, support to navigation, and climate regulation (Halpern et al., 2012).

In this context, the frequent lack of planning in the processes of occupation and urbanization of coastal areas, especially in developing countries, may also generate or aggravate environmental problems (Ernandorena, 2003; Polette and Lins de Barros, 2012). Policies for management and planning of CZs must be able to promote conservation and sustainable development in an effective and balanced way, into the scope of integrated coastal management – ICM (Cicin-Sain and Knecht, 1998; Westmacott, 2001). Different

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interests of political, social, economic, cultural and conservationist orders should be considered in the processes for compatibilization of use and occupation of CZs (Polette and Silva, 2003). To integrate these multiple perspectives, the adoption of participatory management practices, with strong engagement of civil society, is considered essential (GESAMP, 1996; Edwards et al., 1997; Ellsworth et al., 1997; Christie, 2005; Sousa et al., 2013).

In the ICM process, instruments focused on planning and control of uses of marine space, such as Marine Spatial Planning - MSP (Ehler, 2003; Douvère, 2008) and the establishment of Marine Protected Areas - MPAs (Mangi and Austen, 2008; Abecasis et al., 2013), together with those focused on public planning and decision making, such as Environmental Impact Assessment - EIA (Saarikoski, 2000; Saidi, 2010; Sánchez and André, 2013) and Strategic Environmental Assessment - SAE (Fischer, 2003; Bidstrup and Hansen, 2014), have been highlighted. Considering the EIA framework, the first country to establish the legal basis for its implementation was the US, by the National Environmental Policy Act in 1969 (Ortolano and Shepherd, 1995; Fischer, 2003; Saidi, 2010). After the US, many countries followed this example (Ortolano and Shepherd, 1995; Saidi, 2010) including Brazil, which established EIA as an instrument of the National Environmental Policy in 1981 (Law No. 6938, 1981).

The main objective of the EIA is to provide information to public planning processes and decision-making considering projects (or enterprises) proposed to a specific region, its alternatives and environmental impacts caused by its implementation (Ortolano and Shepherd, 1995; Saidi, 2010). Although this instrument has been successfully implemented in several countries, there are failures, difficulties and limits related to its use. In many cases, the elaboration of EIA lacks of preterit data, time to support the necessary studies and effective monitoring programs (Ortolano and Shepherd, 1995; Oliveira and Bursztyn, 2001). Additionally, it is also unable to assess cumulative and synergistic impacts generated by different enterprises (Oliveira and Bursztyn, 2001; Teixeira, 2013). Beside these problems, public participation in EIA and the integration of EIA into the public planning process occurs belatedly, which hinders the proposition of alternatives for a given project and the consideration of opinions, perceptions and values from affected actors in this process (Ortolano and Shepherd, 1995; Oliveira and Bursztyn, 2001). In many cases, EIA works only as a formality of the licensing process and is used just to legitimize already taken decisions, or to pretend that the local population's claims will be considered through the public consultation process (Ortolano and Shepherd, 1995; Oliveira and Bursztyn, 2001).

In areas where scientific data about CZs are scarce, as in tropical and developing countries, the absence of environmental data becomes a particularly significant problem (Ruddle, 2000; Diegues, 2004). As Jung et al. (2011) highlight, in the absence of time series of quantitative data, which can support the evaluation of changes that have occurred in a particular region, the importance of qualitative information such as those from perceptions of local communities has increased attention as they allow at least a brief description of the environmental changes that have occurred. Understanding perceptions and opinions about the past, present and future state of coastal environments and its resources (GESAMP, 1996), in addition to local knowledge of actors who live in these regions (Webler et al., 1995), can be critical for the development of public policies and for the application of tools such as EIA, into the ICM processes. Moreover, it can reveal people's opinions and knowledge in a suitable way to democratic decision-making.

Conceptually, environmental perception can be understood as the awareness and the human understanding of the environment in a general way (Whyte, 1977). This wide definition allows to comprehend the perceptive process without establishing

differences between sensations – which refers to kinetic and biochemical relationship among an individual and the world around him – and cognitions – which refers to mental process mediated by personal culture and knowledge (Whyte, 1977). Many authors have addressed the concept of environmental perception linked to environmental problems, changes and management approaches in coastal and marine areas. Some examples are: Tran et al. (2002), who investigated coastal changes as perceived by residents from Holbox Island (Mexico); Peterlin et al. (2005), who evaluated differences between the perceptions of workers from Port of Koper (Slovene) and the remaining local population, regarding sources of marine pollution, air pollution and noise generation; Friesinger and Bernatchez (2010), who analyzed people perceptions about coastal erosion, decrease of ice cover and increase of storms in the Gulf of St. Lawrence (Canada); and Jung et al. (2011), who observed changes in fish fauna since 1950s, analyzing the perceptions of fishermen and divers in Port Phillip Bay (Australia).

All these authors had success in accessing local stakeholders' perceptions and translating it to valuable and useful information for coastal conservation and management. In this work, we aimed to reinforce this usefulness in ICM, in a specific case, applying it to provide preterit data to EIA process. For that, perceptions from local stakeholders who live near to and have been visiting the Araçá Bay (northeast coast of São Paulo State, Brazil) for a long period of time were used to obtain qualitative preterit data about local environmental changes and impacts related to enterprises that were implemented in Araçá Bay's vicinities. After data analysis, results of stakeholder's perceptions were compared to available documents that registered environmental impacts for the same area (e.g.: the first EIA made in the region in 1987, as part of the local port expansion). Through this approach, we expected to provide information both for impact assessment, coastal planning and management in a local scale.

2. Materials and methods

2.1. Study area

The Araçá Bay (Fig. 1) is a small bay which comprises an area of approximately 550,000 m² located next to the urban city center of São Sebastião, on the north coast of São Paulo State (Brazil). This area contains one of the last remnants of mangrove forests in the region, and support great environmental complexity and high biological diversity, where more than 700 species were identified up to 2010 (Amaral et al., 2010). Considering the ecological importance of the bay, its space was inserted into the Marine Protected Area of the Northern Coast of São Paulo State created in 2008. Despite being a spot of high ecological value and considered to be a "opencast" laboratory (Amaral et al., 2010), the bay suffered interventions and anthropogenic impacts that were intensified after the middle of the twentieth century (Cunha, 2003; Francisco and Carvalho, 2003). Although scientific research in the bay dates back to 1950, studies were limited to few sites and they were concentrated in specific areas of knowledge (Amaral et al., 2010). Thus, they do not support a broad understanding of the environmental status of Araçá Bay previously to human interventions; nor do they report the many environmental changes derived from such interventions and anthropogenic impacts.

2.1.1. Historical reconstruction: local events (buildings and enterprises) that had affected the Araçá Bay in the past years

The beginning of the occupation of the region, where is currently the city of São Sebastião, occurred during Brazil's colonization, in the mid-sixteenth century (Ressurreição, 2002).

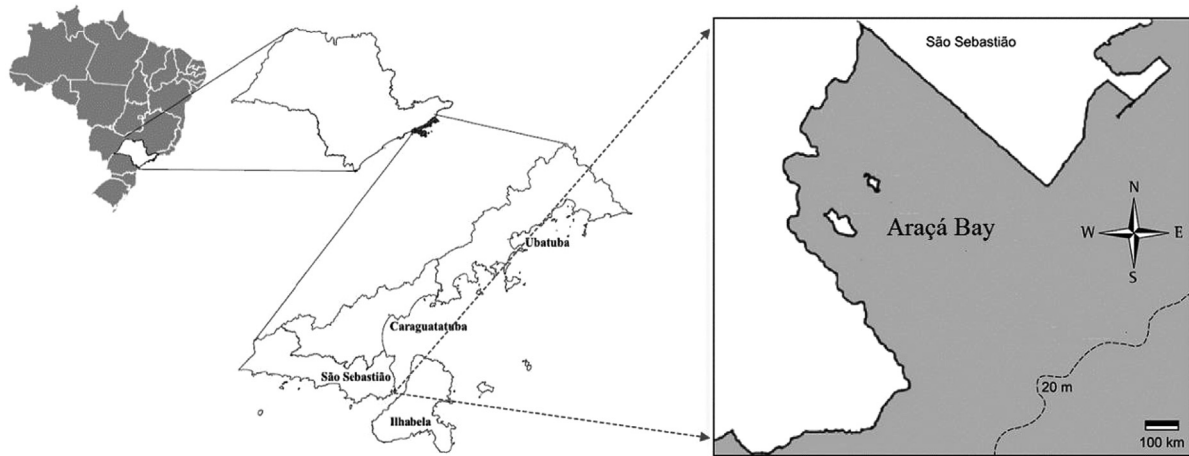


Fig. 1. Study area: the North Coast of São Paulo State focusing on Araçá Bay. (Adapted from Amaral et al., 2010).

Although the colonization of São Sebastião has begun in the sixteenth century, the most significant human actions (that began led to transformations in the local coastal zone) only started after the beginning of twentieth century. In this context, the first major change in the study area was, undoubtedly, the construction of the local port, the Port of São Sebastião, between 1936 and 1954 (Albuquerque, 2013). Such action formed a barrier that divided the previously continuous coast, creating the Araçá Bay and definitely marking the interest for port uses in the region.

Despite the construction of the port, Araçá Bay changed little in the following years. Few families resided in the Bay's surrounding area, with small and punctual buildings near Bay's borders, and the bay it was used only sporadically by local gatherers and artisanal fishermen (Ressurreição, 2002). However, this reality gradually changed from the 1950s when other major local interventions happened:

- The expansion of the Port of São Sebastião conducted in two phases – the 1st phase began in 1972 and the 2nd (the only construction from 1950 to 2000 that had an EIA in the region) began in 1987. This expansion process generated successive landfills built over part of the Araçá Bay and over an old beach that existed in front of the historic center of the city, to the north of the port.
- The construction of the Maritime Terminal Almirante Barroso (TEBAR), the largest terminal for storage and outflow of oil in Brazil – carried out between the 1970s and 1980s. During this period, two hills located in TEBAR area were demolished and the resulting material was assigned to the port for the construction of the landfills previously cited.
- The paving of the highways SP-99 and SP-55 (main access roads to the region) that took place in the 1980s and allowed the rapid urban growth in the region (driven by job opportunities and the tourism development).
- The construction of a Submarine Sewage Outfall in the Bay in 1990 – the sewage pipe was installed after a process of dredging that crossed the bay's floor, which probably altered sediments patterns and benthic fauna. This outfall has since been operating without having been licensed by the competent agency.

After 1990s, with the economic domination of port and oil activities in the region, the surroundings of Araçá Bay became a highly urbanized area, where multiple uses and activities take place (Ressurreição, 2002). Despite these changes and imposed

pressures, the bay resists and remains as an important marine place for research, biodiversity conservation and the continuity of traditional fisheries by the remaining traditional community that lives in its vicinity (Amaral et al., 2010), indicating the importance of the maintenance of Araçá Bay's environmental quality.

However, debates on new and big projects planned for the region that threaten the Bay have been intensified lately (Legaspe, 2012; Utsunomiya, 2014). The main projects under discussion are: a new proposal for expansion of the local port, which foresees the occupation of more than a half of the current area of the Bay; the expansion of the access roads to the region (which will facilitate the outflow of products, especially if the expansion of the port occurs); the pre-salt oil exploration program, which although happening in Atlantic Slope at approximately 250 km distant from São Sebastião may result in local impacts since there will be a increase in ship navigation in the surrounding areas; and the expansion of the oil terminal - TEBAR (to supply the Brazilian pre-salt program demand). Unfortunately, although the many economic benefits that can be provided by these proposed projects, they can also potentially increase disturbances and conflicts over the Araçá Bay.

As local history indicates, previous interventions (summarized in Fig. 2) associated with absence of local planning (Cunha, 2003) have already led to a series of environmental impacts and social conflicts that have not been investigated yet. This raises the need for research initiatives capable to identify local changes and problems (induced by human actions) that can help decision and policy makers to develop appropriate management actions.

2.2. Data collection and analysis

The different perceptions of local community about Araçá Bay's environment and its changes were investigated by performing interviews following a semi-structured script (guide). The interviews were conducted as a conversation, enabling some flexibility and freedom to discuss predefined themes (Combesse, 2004). The interview script (Table 1) consisted in a list of topics to be addressed according to the objectives of the research. Part I was developed to characterize stakeholders' uses and their different relationship with local environment in the bay; Part II was focused in their memories and perceptions about past environmental changes and impacts; and Part III comprised their perspectives and opinions about the future of Araçá Bay.

Due to the historical characteristic of this study, it was decided to approach a specific group of users: people who accompanied the transformations that the local suffered in the past, from the 1970s,

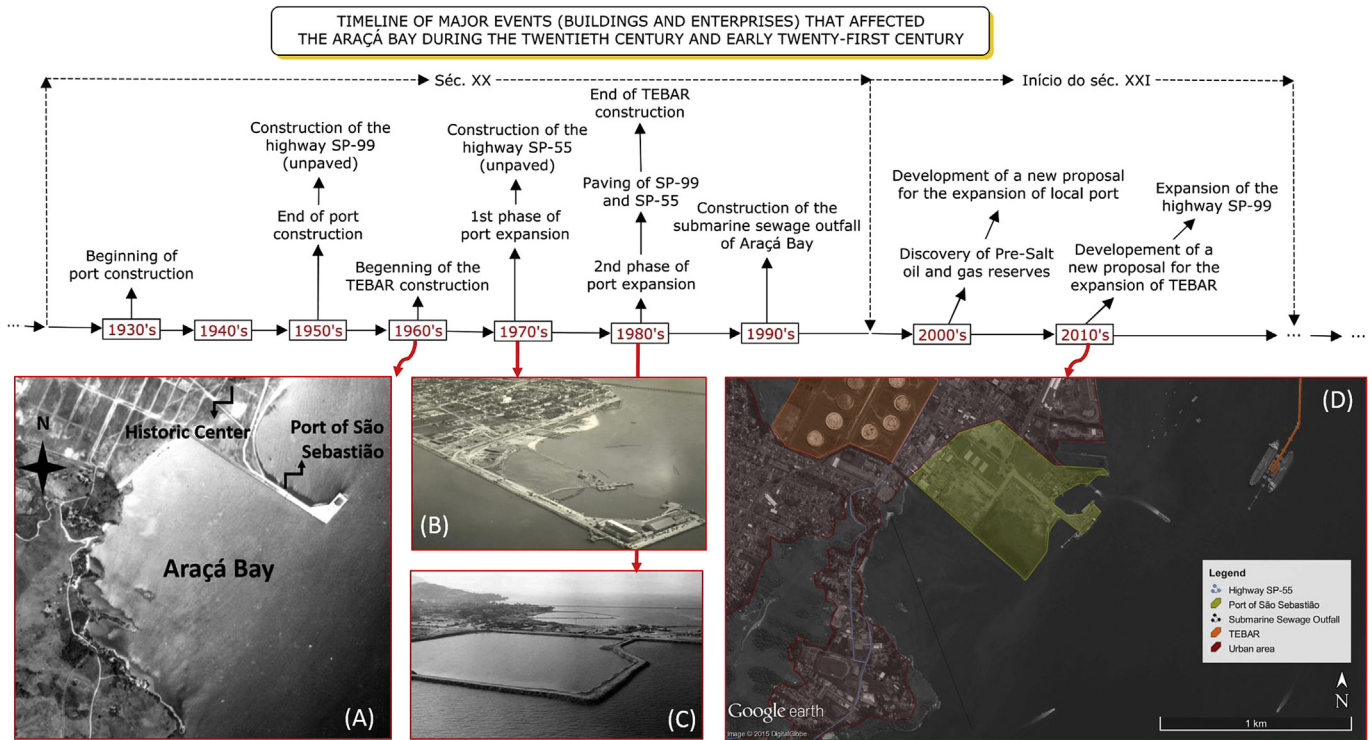


Fig. 2. Timeline of major events that affected the Araçá Bay in the last decades. Image sources: A, B and C: collection of the department of historical and cultural heritage of São Sebastião (accessed in April/2014); D: Google earth (accessed in March/2015).

Table 1
Semi-structured script and topics covered.

| Stretches of the interview | Guide of issues to be discussed |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part I: Personal information of the interviewees and their relationship with the Araçá Bay | Name and age Time living nearby and visiting the bay Local uses and activities known to be performed in the Bay Opinions about the importance of the local environment |
| Part II: Memories about changes in the Bay | Memories about changes and impacts in the Bay and when they occurred |
| Part III: Future perspectives | Expectations and opinions about the future of the Bay |

1980s to the early 1990s. In order to accomplish this requirement, interviews were only conducted with stakeholders that have been living in the area, frequenting the Araçá Bay and performing activities there for a long period of time (at least three decades). The identification of these “target stakeholders” started with a prior visit to the Bay, which enabled the identification of people with the desired profile. Thereafter, we applied the “snowball” technique (Wright and Stein, 2005), by which interviewees indicate other people who fit the same profile, repeating the technique with every new interviewee until no new stakeholders were identified.

Between July 2012 and July 2013, twenty-four people who fulfilled sampling requirements were identified and seventeen were interviewed (71% of the sampling population). All seventeen interviewees were briefly informed about the research and anonymity of the information provided, and freely accepted to participate. The others do not accepted to answer the interview or could not answer at the time that we contacted them.

All interviews were recorded with a digital voice recorder and were transcribed for qualitative examination through the speech analysis technique (Fiorin, 2000; Capelle et al., 2003). Interviewees’ answers were organized and grouped into similar categories, which allowed the identification and accounting (from the more cited to less the cited impacts) of major past changes and environmental impacts reported to the Araçá Bay.

Preterit impacts identified in interviewees perceptions were compared with impact evidences found in literature and with historic photographs (which allowed us observe major spatial changes) to verify its accuracy. Posteriorly, perceive impacts were also compared with the first and single environmental impact assessment (EIA) carried out in the region of Araçá Bay between the 1950s and 2000, to verify differences between the impacts predicted in this EIA and the impacts identified by stakeholders perceptions. This EIA was presented in 1987 by the Waterways Department (body responsible for the administration of the Port of São Sebastião at the time) as a requirement to expand the port area in the late 1980s. Such comparison enabled the identification of gaps and failures on it.

3. Results

3.1. Main information about the interviewees

The interviewees had 55 years old and frequented Araçá Bay for 48 years, on average, indicating their long-time relationship with the area (Table 2). In total, eight of them attend the Bay for more than five decades while the others attend it for at least three decades. The majority of men are local fishermen and women are housewives. All interviewees live in the vicinity of the bay or in

Table 2
General data about the interviewees.

| | Abbreviation of the name | Age | For how long frequent the bay | Gender |
|----------------------------------------------------------|--------------------------|---------------|-------------------------------|------------------|
| 1 | A.C. | 58 | 54 | M |
| 2 | B.O. | 75 | 45 | M |
| 3 | T.N.J. | 67 | 67 | M |
| 4 | M.N.J. | 71 | 71 | M |
| 5 | A.S. | 38 | 38 | F |
| 6 | E.N. | 63 | 55 | M |
| 7 | E.O. | 33 | 33 | F |
| 8 | J.R. | 55 | 35 | M |
| 9 | M.A.S. | 48 | 33 | M |
| 10 | M.A. | 66 | 66 | F |
| 11 | M.L.C.S. | 74 | 74 | F |
| 12 | M.R.S. | 60 | 31 | F |
| 13 | N.N.B. | 42 | 38 | M |
| 14 | O.F.S. | 56 | 56 | M |
| 15 | R.R.F. | 54 | 54 | M |
| 16 | S.G. | 40 | 38 | M |
| 17 | L.C. | 43 | 43 | M |
| Average | | 55 ± 13 years | 48 ± 14 years | |
| Relative frequency (%) of each gender among interviewees | | | 70.6% M (male) | 29.4% F (female) |

neighboring areas and 70% had their first contact with the Bay during childhood.

3.2. Uses and perceptions of the importance of Araçá Bay

Among the main uses identified in the interviews (Table 3), fishing and clam harvesting stood out as the main livelihood activities. *"In fact, that area over there used to serve for everything. To fish, for picking up clams, crab fishing, seafood, and others... We used to go there to get something to eat, for feeding..."* (E. N., 63). According to researchers that work on the Bay (Amaral et al., 2010; Fagundes et al., 2014) and to the interviewees themselves, the major groups of organisms collected are molluscs, crustaceans and fishes: *"Here we come to catch crab (Callinectes sp.), red crab (Mennipe nodifrons), clams (Anomalocardia brasiliana and Tivela mactroides), and sometimes to fish, because here there are a lot of fish too..."* (M. A., 66). Among the other uses and activities, it is worth mentioning the organization of regattas (leisure) and the use of the Bay as shelter for small boats: *"Twice a year we held the regatta..."* (N. N. B., 42); *"We promote canoe and kayak races (regatta)... And it is also a fishing spot and a shelter for vessels when the sea is rough..."* (R. R. F., 55).

Tied to the prevailing uses and activities, the interviewees also expressed their views and perceptions on the importance of Araçá Bay. All of them mentioned the ecological importance of the Bay, in addition to issues of emotional, sociocultural and economic values.

"The Araçá means everything for us. It is the stage of our childhood and until now it's from where we take almost all of

our livelihood. Besides fishing, there is leisure. If you take Araçá away from us, everyone 'die'." (M. N. J., 71).

"The Bay is an important area until the present days because, beyond all of that, it is also a nursery spot, a natural habitat for the reproduction of all species of marine fish and crustaceans. Just go there when you come in November and you will see that it is full of young shrimp growing all around." (E. N., 63).

"Some people look at the Araçá and gives nothing, but here is a very rich spot..." (E. O., 33).

"The important thing is that what I fish and sell increases my income because I'm retired. It helps me on my expenses." (T. N., 67).

"The Bay for me is fundamental, it is my life. I live in the light of it. I wake up and I go fishing. Late in the night I fish. Indeed, today I have already come to fish and I fished a 'Mullet' (a fish from the family of Mugilidae). I usually say that 40% of my family income comes from Araçá Bay." (N. N. B., 42).

3.3. Perceptions of changes and impacts that occurred in Araçá Bay

Five major categories of environmental changes in the Bay were reported (Table 4) and, when reporting these changes, the interviewees also indicated which human actions could have been responsible for them. The main cited factors were the expansion of the local port (cited by 88% of interviewees), the installation of the

Table 3
Uses and activities practiced by interviewees at Araçá Bay.

| | Uses and activities practiced by the interviewees at Araçá Bay ^a | Number of interviewees who mentioned each use | Relative frequency (%) |
|---|-----------------------------------------------------------------------------|-----------------------------------------------|------------------------|
| 1 | Fishing and clam harvesting | 15 | 88 |
| 2 | Leisure | 11 | 65 |
| 3 | Boarding/docking | 7 | 41 |
| 4 | Environmental education | 4 | 23 |

1 – includes those who fish often or eventually in the area and those who used to fish but do not practice it any more.

2 – includes swimming, regattas, etc.

3 – refers to the use of the area as mooring for small boats, canoes (motorized or not), and others.

4 – refers to the use of the Bay as an informal basis for education for schools and the community.

^a Non-excludent uses (same people practice different uses).

Table 4
Category classification of major environmental changes that occurred in Araçá Bay (on the abiotic and biotic environments) cited by the interviewees and evidences of the same changes from available material (e.g.: historic and aerial photographs) or scientific studies.

| Categories | Citations | Passages of interviews | Impact evidences from other sources |
|---------------------------------------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Changes in the spatial configuration of the Bay and its coastline | 15 (88%) | <i>"Today you look and see a landed area. Before it was not like that." (A.S., 38). "There it was Areião Beach but it was embanked, landed. On that area there was a group that used it to anchor the boat, only to arrive and unload. That was a beautiful beach, boy! And they landed it..." (O.F.S., 56)</i> | The area of Araçá Bay decreased from approximately 850,000 m ² in 1960s to about 550,000m ² in the present (see Fig. 3), after the landfills built during the harbor expansions in 1970s and 1980s. |
| 2. Changes in the hydrodynamic and sedimentary characteristics of the Bay | 13 (76%) | <i>"Formerly it was a firm sand until the center..." (M. L., 74 years). "The floor got softer. We sink down when we walked here. Now it's getting more compressed, but it was very bad." (R.R.F., 55). "It has changed because we no longer saw the circulation of the seawater inside the Bay." (S.F.O., 56)</i> | Villamarin (2014) demonstrated experimentally (by modelling techniques) that retention time of particles may have been reduced from 3.6 days (before port construction), to 6.7 days in nowadays. Lopes (1993), Amaral and Morgado (1994), and Belúcio (1995) reported changes in sedimentary patterns after the construction of the submarine outfall. |
| 3. Pollution of the Bay | 10 (58%) | <i>"There's a lot of garbage and plastic bag. They throw it away on rivers and everything end here..." (R.R.F., 55). "We see a lot of sewage discharge, mainly from 'Mãe Isabel' River (a small river that flows into the Bay), which comes from houses from neighborhood." (N. N. B., 42).</i> | CETESB (2006) estimated that about 12,000 m ³ /day of sewage are discharged by the outfall. Gubitoso et al. (2008) and Teodoro et al. (2010) found anoxic sediments near of the submarine outfall output, related to bacterial activities over the sewage discharges. According to Amaral et al. (2010), there are also clearly evidences of irregular sewage dump and solid waste on the bay. Moreover, more than 200 accidents related to oil and gas operation in TEBAR occurred in Araçá's Bay surroundings until 2000s (Cunha, 2003). |
| 4. Changes and reduction in marine fauna | 9 (53%) | <i>"Oh, there were much more fishes and lives in this mangrove before they started to ground and hedge the Bay. There were some species that no longer exist and gradually disappeared." (G.S., 40)</i> | Although no study about local fish dynamics is available, Amaral and Morgado (1994) noticed a great mortality of benthic fauna after the submarine outfall installation, which the authors related to changes in local sediment dynamics, also compatible with the changes related to the other enterprises. |
| 5. Decrease of mangrove coverage areas | 8 (47%) | <i>"This mangrove here, this piece of mangrove was almost connected to the other one. The destruction was so great that destroyed such mangrove forest." (A.C., 58)</i> | Mangrove areas decrease from approximately 7,000 m ² in 1960s to about 3,000 m ² in 2015 (see Fig. 4). |

Submarine Sewage Outfall of Araçá (cited by 58%) and the construction of TEBAR (cited by 35%).

Considering interviewee's perceptions, the most reported category was "changes in the spatial configuration of the Bay and its coastline" (Table 4). As perceived in aerial photographs of the area (Fig. 3), successive landfills related to harbor expansion were installed in the bay, which changed its configuration and led to a reduction of its total area. The second most cited change ("changes in the hydrodynamic and sedimentary characteristics of the bay") is related to the first one, since the construction of successive landfill areas reduced the magnitude of hydrodynamic forces (Villamarin, 2014), which corroborates with interviewees perceptions.

Examples of the first and second most cited changes (categories 1 and 2) that remains in the memory of interviewees are, respectively: the disappearance of the former Areião Beach, currently occupied by Port landfills; and the disappearance of a small old channel that separated two areas of mangrove where people could swim and fish. These two specific changes were mainly reported by the oldest interviewees. Their speech also revealed their affection by the Bay when they were describing these memories.

"With the dredging and the landfills (to give place to the port) we lost our dear Areião Beach. Our princess of the sea disappeared, she was landed (during port expansion in the 1980s)." (M. N. J., 71);

"It has changed, it has changed. Do you know why? That landfill overthere didn't exist. The whole area over there was grounded." (B. O., 75).

"Over there was a inlet that formed a type of channel, a small waterway. I used to dive frequently in that place and it has all been destroyed by the construction of the Port over there and by this landfill constructed there." (A. C., 58).

"Here there was a kind of swimming pool (the same channel cited before). It was around 30 m long. With the tide it got 2 m

deep. When the tide was low it formed a pool over there and I used to catch a lot of shrimp... But as time went by, it was landed as you know" (T. N., 67).

The "pollution of the Bay" (third most mentioned change), which includes sewages discharges and oil spills, was widely reported in local literature (see Table 4). "Changes and reduction in marine fauna" (fourth cited change) were noticed by interviewees and also reported by scientific data, specifically regarding benthic fauna (Amaral and Morgado, 1994). Regarding other components of local marine fauna such as fish population, no research was found to support the statement. However, considering the trophic dynamic of marine environment (Odum and Heald, 1972; Wolff et al., 2000) and the fact that the impact in lower levels of the trophic web can perpetuate through the web (Kang et al., 2003), it is reasonable to assume that reduction in benthic fauna affected higher levels of the web. Moreover, considering the importance of the mangrove system as reproduction and nursery site, it is highly probable that the identified decrease of mangrove coverage (category 5) also affected the whole trophic web, including top predators as fishes.

The last major reported change was the "decrease of mangrove coverage areas" (Table 4). There is no published research to support this statement, but a comparison between historical photographs allowed to verify this change and roughly estimate its magnitude. Through the photographs analysis (Fig. 4), it is possible to identify a reduction of mangrove areas from about 57% between 1960s and nowadays, which corroborates with the perceptions of interviewees.

Minor factors and changes that happened in the Bay may have been underestimated or neglected by the interviewers. Local impacts related to the presence of a highway with great movement of vehicles, and to constructions in environmentally vulnerable areas along the waterfront (such as houses, walls, barriers and even streets in areas that originally were beaches and rocky shores),

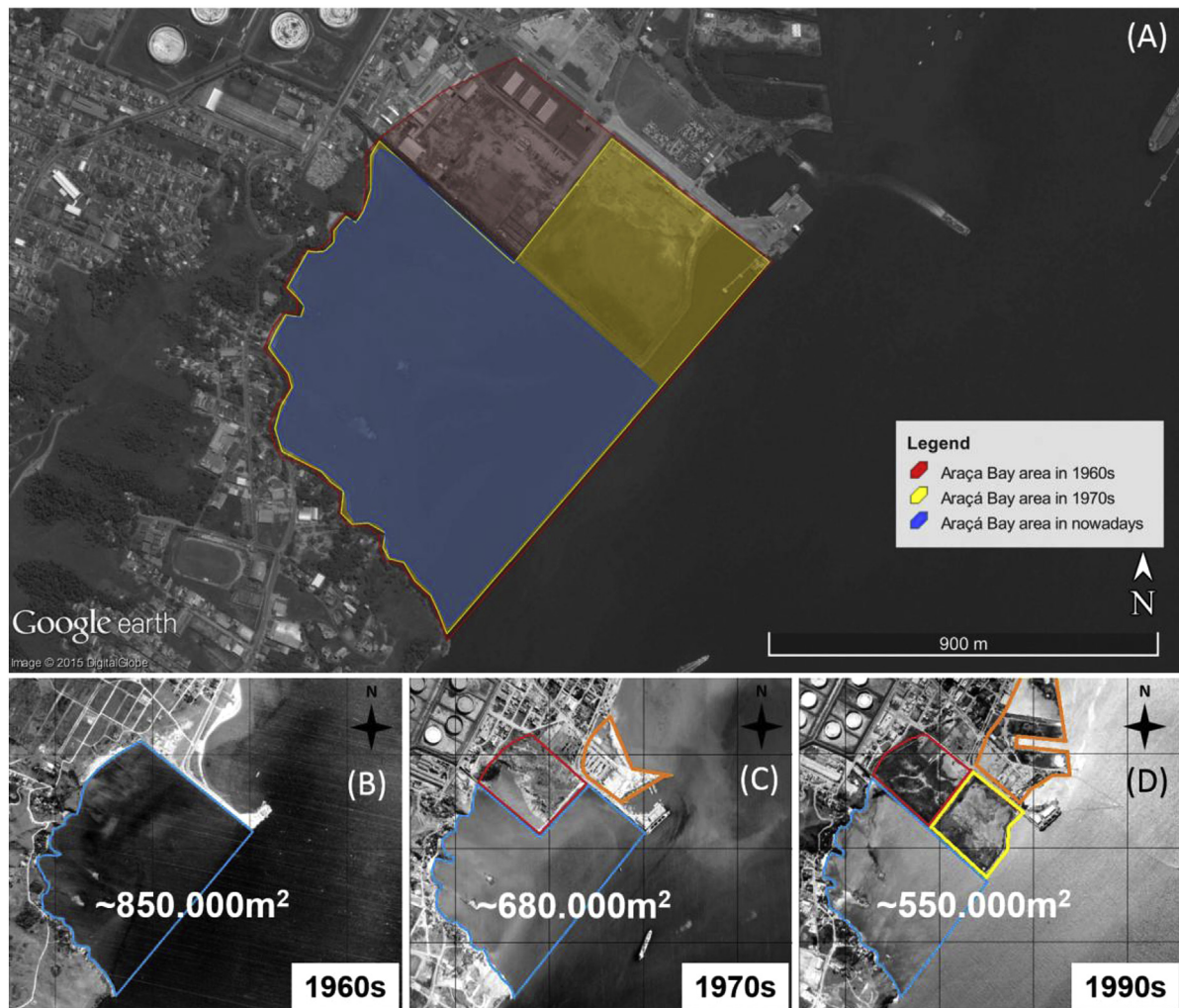


Fig. 3. Evolution of landfills during the harbor expansion and reduction of Araçá Bay area from 1960s to nowadays. Image sources: A: Google earth (accessed in March/2015); B, C and D: Collection of the Docks Company of São Sebastião (accessed in April/2014).

were not mentioned by the respondents. Only one of the interviewees associated population and urban growth in the surroundings with the reported changes and impacts at the Bay. Nevertheless, some interviewees also cited another important issue: the resistance, resilience and natural adaptation of Araçá Bay after the interventions that occurred. There were no questions directed to this issue, however these perceptions appeared naturally in the speech of interviewees.

“People pick clam and crab to sell, even with all this environmental aggression. Over there has oil discharges, sewage, remains of debris. Even with these impacts nature resists...” (E. N., 63).

“I see that it (the bay environment) has changed a lot, it suffered and suffers a lot, but it is resistant. It is resistant because it has two periods: when the tide fills and when it leaks. Therefore, the environment is filtered for 12 h. There are six hours to fill and six hours to leak. Depending on the moon, tide is greater and leaks much more. It happens every day. That is why the Araçá is not rotten or much polluted (referring to the water quality)...” (N. N. B., 42).

“With the years it (environment) got better. The land is returning to where it was before.” (E. O., 33).

3.4. Differences between the EIA presented in 1987 (for the port expansion) and the preterit impacts perceived by the interviewees

The referred EIA carried out in 1987, was prepared by the port authority as a requirement of the licensing process for the expansion of the Port of São Sebastião. It was one of the first EIAs performed in Brazil after the decree of a federal resolution in 1986, which established the obligation of assessing environmental impacts for buildings and enterprises with high potential for environmental impact. According to this EIA, the creation of landfill areas in the Bay for the expansion of the port (Fig. 4) would not affect the abiotic environment (hydrodynamic and sedimentary process) and it would cause minimal negative impacts on the local biota, only affecting benthic invertebrates living in the area where the grounding would happen (DH, 1987). Furthermore, the socio-economic characteristics would only be affected positively, once new jobs would be demanded by the project (DH, 1987).

“After analyzing the main features of the local physical environment (tides, sedimentology, coastal currents and sea waves), and the expansion activities of the port, it is concluded that they do not have negative effects on the physical environment. (...)

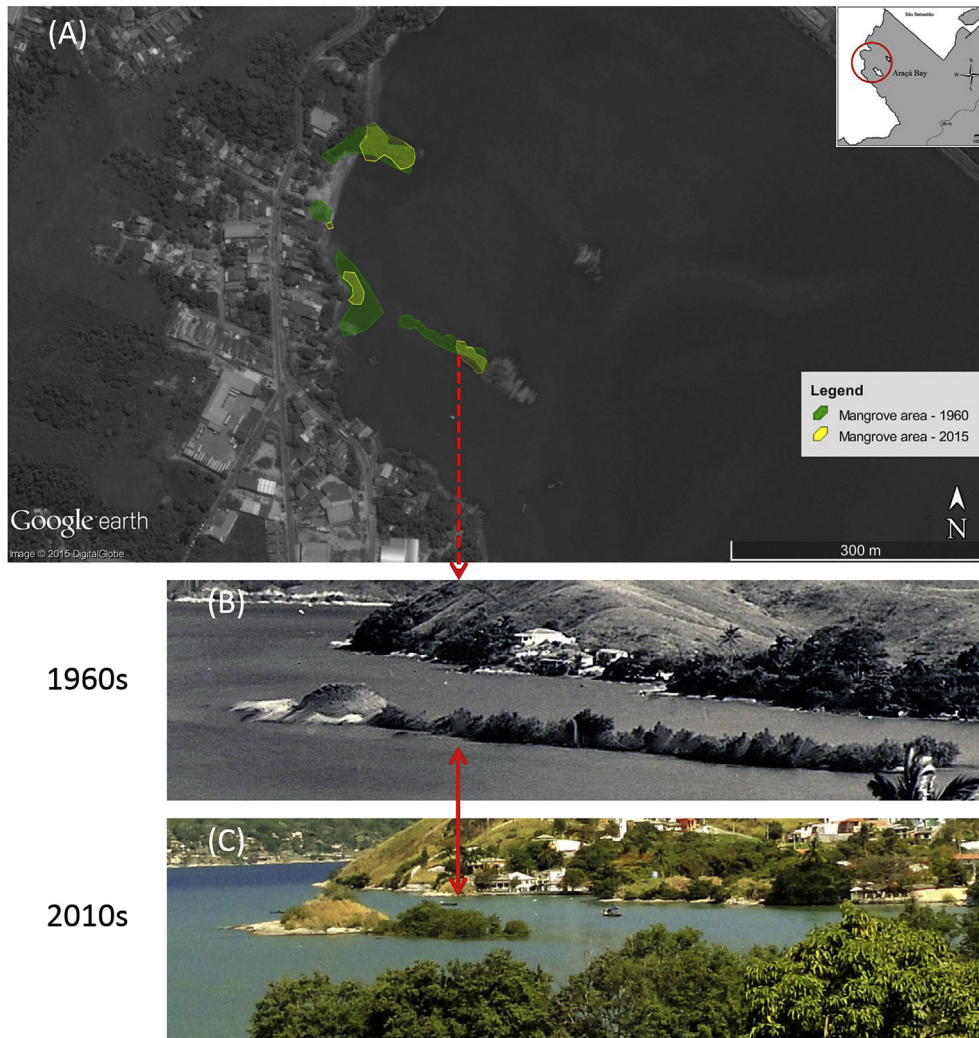


Fig. 4. Comparison between mangrove areas in 1960s and 2010s (A), which decreases from approximately 7,000 m² to about 3,000 m². Zoom to one of the mangrove sites exemplifying the reduction that affected the whole bay (B and C). Image sources: A: Google earth (accessed in March/2015); B: collection of the department of historical and cultural heritage of São Sebastião (accessed in April/2014); and C: PERES, C. M. (photographed in March/2014).

The impacts of the hydraulic embankment on this environment (referring to biota) affect only the colony of organisms (giant worms, molluscs and polychaetes) that have their habitat in the area where the activities for the expansion of the port of São Sebastião will be implemented.” (DH, 1987).

Port activities have high potential for transforming coastal environments. Various negative impacts (such as suppression of vegetation, changes in hydrodynamics, and pollution) can occur due to installation, operation and maintenance of the required infrastructure, and to process related to storage and of trade of goods (Reis, 2011; Lopes, 2013). Despite the impacts pointed out by this EIA, the perceptions of the interviewees and the documents analyzed highlight that the expansion of the port has generated significant impacts on the environment, which have been underestimated. As an example, the creation of landfill areas that occupied part of Araçá Bay has led to a decrease in the intensity of hydrodynamic processes and to an intensification of sedimentation processes. In addition, the impacts on local biota affected the entire food web, reaching other species that occurred in the bay, such as fishes and shrimps. Consequently, socioeconomic aspects were also negatively affected due to the reduction of availability of marine

organisms to traditional harvesting and fishing by local community.

3.5. Expected future for Araçá Bay in the opinion of the interviewees

All interviewees were in favor of conservation measures to Araçá Bay. Many of them agree on the statement that the configuration of the bay should be kept as it is, without further interventions and area depletion for port activities, and that the input of sewage and other pollutants should be better monitored and controlled. The expectation is that with these actions local environment could recover naturally.

“In my opinion, as it has already took longer than 15 years to recover, we should leave it as it is. With that, the nature itself gets in charge...” (O. F., 56).

“I would not change anything. I would leave the bay in the way it is and only improve the issue of the sewage that is being released here. I would let it recover by itself (the Araçá Bay). Even if slowly, it is already getting better.” (N. N. B., 42).

When considering the possibility of a further expansion of the

port, it was evident the concern regarding its negative consequences. All of them expect that, in this scenario, all necessary and feasible actions will be taken in order to minimize the environmental impacts. Moreover, they foresee that such expansion may decrease the environmental quality of the Bay and of the life of those living in the surrounding area.

“Of course it will generate employment and development, and that everyone needs these, needs to grow. But we have to grow with caution. I think they should make a structure where marine life could be maintained, with water flow. Of course there must have some way, mustn't it?! Because if they construct a new landfill, this place will be over...” (S. G., 40).

“It is ok if the Port expand, but do it without damaging the area. I do not think that landfill the area is necessary. Leave it there in peace...” (E. N., 63).

“Imagine if over there was preserved, wouldn't be better?! I believe that if one day there will be destroyed, we will lose a lot and that will be a great aggression to the environment, especially for marine species...” (E. N., 63).

“It never remains the same. It will be need to dig, add concrete...” (...) “Imagine the greatness of an intervention like this...” (E. O., 33).

“Well, depending on what happens or they will take us out of here or the people who do not want low life quality will desire to leave...” (A. S., 38).

4. Discussion

4.1. Interviewee's perceptions and its contributions to EIA

As observed by Jung et al. (2011) and Taylor et al. (2011), perceptions of people that live in a particular place for a long period of time and accompanied its historical evolution, can be considered a diagnosis of preterit environmental reality of the location, enabling a direct comparison between past and present. Perceptions of the changes that occurred in Araçá Bay can be considered reports of the changes that the site suffered over time, guided by different interests (e.g. naval uses, extractive uses, trade, tourism, industry and housing activities).

According to the results, the stakeholders interviewed in this study observed several changes in Araçá Bay as in spatial and coastline configuration, in hydrodynamic and in sedimentary process, besides the reduction of mangroves and local marine biota. Evidences in literature and historic photographs corroborates with these perceptions, which contradicts the statements of the EIA of expansion of the Port of São Sebastião (made in 1987). Based on this understanding, it is clear that this EIA underestimated the environmental impacts resulted from the port expansion at the time.

However, localized impacts associated to the construction of streets, houses and walls on the edge of the bay were not mentioned. It may have resulted from the lower visibility of these factors when compared to those related to greater interventions in the area. As noted by Tran et al. (2002), greater and abrupt environmental changes are more explicit and easier to be perceived by local communities. Moreover, most of the interviewees and their families live and use these areas, developing a close familiarity with these smaller constructions and being benefited by their use. Such familiarity and benefits can cause these people to underestimate the impacts associated to these forms of occupation (Peterlin et al., 2005).

Other perceptions, as those about the resistance and slow

recovery of the bay, due to factors such as water exchanges by tidal currents, evidence the resilience of the area and the importance of oceanographic factors to maintain this environment. In the case of a new port expansion and a decrease on water circulation, the water exchanges in Araçá Bay can reduce and the retention of pollutants and organic matter can increase, affecting the water quality and the resilience and recovery of the Bay.

Even though long-term environmental changes are difficult to be measured by coastal communities, hindering to point out the magnitude and causes of each change accurately, the perceptions reported in this research are evidences of cumulative and diffuse effects of the great interventions and buildings that occurred in the Araçá Bay region. In this sense, future studies based on local ecological knowledge of the community can deepen the understanding of the occurred environmental changes (Johannes, 1993; Ruddle, 2000; Diegues, 2004; Taylor et al., 2011). Moreover, scientific data can be associated to local ecological knowledge and perceptions of local populations, making it possible to define more precisely the factors and events affecting coastal system (Friesinger and Bernatchez, 2010).

The perceptions of the natural environment and its changes are influenced by different factors and it is difficult to determine precisely which are the most important (Peterlin et al., 2005). Cultural features, individual lifestyle (Abecasis et al., 2013), and also the different forms that each person interacts with the same environment (Hoeffel et al., 2008; Jung et al., 2011), are strongly linked to the perceptions and values that are inputted to marine environments. This influences views and opinions about the importance of these spaces. Public campaigns of awareness and environmental education can promote a better understanding of the multiple causes of deterioration of local environment, serving as a useful tool in this context. They influence behavior and attitudes, and motivate people to act proactively to solve or minimize the environmental problems (Tran et al., 2002).

In Araçá Bay, the fact that 88% of respondents use the site for the practice of traditional fishing and clam harvesting as a subsistence activity evidences the importance of the Bay for the food security of these families and their lifestyle. This may have contributed to the predominance of speeches that highlights the taxonomic richness and biodiversity of the area. This was observed in all the interviews, as well as for the affective values attributed to the region, observed mainly in the speeches of those who lived in Araçá during their childhood. Such dependence on the resources and environmental services of the Bay, for they own consumption or as a complement to family income, can also be considered an indication of the strong socio-cultural and economic link between these people and the local marine environment (Abecasis et al., 2013).

Although this study did not aim to identify aspects of the “Caiçara” tradition (traditional people that live on the coast of São Paulo), characteristics found among the interviewees, as the maintenance of fishing traditions and empirical knowledge of ecological and physical aspects of local marine environment, indicate that many still preserve traces of this culture (Adams, 2000; Carvalho, 2010). For the Caiçaras, whose daily lives and lifestyles are associated with the elements of the natural landscape and the use of natural marine resources, the perception of the transformations of coastal spaces is very sharp (Adams, 2000).

4.2. Interviewee's perceptions and its usefulness for planning process and decision making

As regards to the future expected for the bay, the views and opinions in favor of the local environment conservation, shared among all participants of this research, can contribute to actions in favor of local sustainability and more effective participation of the

community in the planning and execution of these actions (Abecasis et al., 2013). Even though it was not possible to identify strong social organization and mobilization around the interests and demands of the community, the organization of events as the annual regattas in the bay is an indication that there are stakeholders who can lead this process of local empowerment. It can also strengthen public participation for the negotiation of improvements for living conditions in the region and for the environmental quality of Araçá Bay.

Although these perceptions, aspirations and worldviews are not expressed in formal instruments, they can directly influence the management of natural resources in a society (GESAMP, 1996). Thus, perceptions can provide important information for planning and land management in the region, taking into account the views of those who will be directly affected by these processes (Tran et al., 2002; Jung et al., 2011; Abecasis et al., 2013). Considerate the diversity of interests and perspectives should be taken as priority actions by local governing bodies and civil society (organized or not) for the future development of the coastal region (Tran et al., 2002). This could stimulate the engagement of the population regarding their role in local environmental problems, and strengthen community participation in planning and management processes (Tran et al., 2002).

5. Conclusion

The different perceptions identified in interviews were used as a qualitative database and made it possible to identify the main preterit environmental changes and impacts that have occurred in Araçá Bay. Evidences found in literature and historic photographs corroborated with perception's data. This strengthened the adopted approach and its usefulness into the EIA processes, in the context of the ICM.

In addition, these perceptions also revealed aspects of the daily routine of local community and of their relation with the natural environment of the Bay. The data contained in this paper can be used to inform discussions on planning and integrated management in Araçá Bay since they take into consideration views and knowledge of people who experience the daily routine of local community.

6. Recommendations

Besides contributing to the evaluation of changes and impacts that occurred in Araçá Bay, the interviews performed with local stakeholders, focusing on their perceptions about the local environment, also revealed concerns, opinions, conflicts, interests and expectations of these people in relation to where they live and their future. Understanding these different beliefs and perceptions can facilitate dialogue for conflict mediation and local development, into the ICM process. Considering this, we recommend that to understand and characterize an environmental scenario and the quality of a coastal area, EIAs should considered perception of local communities in order to not only identify unreported environmental changes, but also understand how these communities have been affected by external pressures over time, and how they could be affected by new interventions in their surroundings. This approach can be useful especially in situations of scarce historical data and inhabited sites that have suffered strong human interference. Such action should also promote social inclusion and strengthen the participation of local communities in the planning and management of their territories.

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