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A COMPOSIÇÃO DE TELEOSTEI E ELASMOBRANCHII NO HOLOCENO BRASILEIRO, BAÍA BABITONGA/SC: SUPORTE PARA REFERÊNCIAS ECOLÓGICAS

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Dissertação de mestrado apresentado ao Programa de Pós-Graduação em Biodiversidade Animal da Universidade Federal de Santa Maria (UFSM), como requisito parcial para a obtenção do título de **Mestre em Biodiversidade Animal**.

Orientador: Dr. Sérgio Dias da Silva
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Santa Maria, RS
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DEDICATÓRIA

À minha família, em especial aos meus pais (mãe, pai, e padrastro) e à Joana C. Lopes.

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Fear of failure (or even fear of success) often prevents us from taking an action and putting our creation out there in the world. But a lot of opportunities will be lost if we wait for the things to be right (Zdravko Cvijetic).

RESUMO

A COMPOSIÇÃO DE TELEOSTEI E ELASMOBRANCHII NO HOLOCENO BRASILEIRO, BAÍA BABITONGA/SC: SUPORTE PARA REFERÊNCIAS ECOLÓGICAS

AUTOR: Thiago Fossile
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A pesca artesanal contribui para a seguridade alimentar e a erradicação da pobreza ao proporcionar alimentos, renda e emprego para milhões de pessoas. No entanto, entre vários problemas, o setor sofre com a diminuição dos recursos biológicos e a degradação dos habitats aquáticos, impactando os pescadores costeiros e de pequena escala que possuem dependência dos ecossistemas locais e regionais de onde retiram seu meio de subsistência. A partir do conceito de Síndrome de Mudanças de Linha de Base (*Shifting Baselines Syndrome*), verifica-se a ausência de pontos referenciais adequados para análise de mudanças na composição ictiológica, como subsídios para adequada gestão da pesca. Desta forma, são necessários estudos para levantamento de dados históricos e arqueológicos com o objetivo de identificar a alteração e a evolução espaço-temporal das espécies (ex.: sobrepesca). Assim, o nosso estudo buscou descrever a diversidade da ictiofauna na pré-história brasileira e contribuir para o desenvolvimento de referências ecológicas, a partir da identificação e mensuração de restos faunísticos em sítios arqueológicos na Baía Babitonga, para fins de comparação com informações a respeito da pesca no litoral brasileiro.

Palavras-chave: pesca, captura de pesca, Holoceno, arqueologia

ABSTRACT

COMPOSITION OF TELEOSTEI AND ELASMOBRANCHII IN THE BRAZILIAN HOLOCENE, BABITONGA BAY/ SC: SUPPORT FOR ECOLOGICAL REFERENCES

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Small-scale fisheries contribute to food security and poverty eradication by providing food, income and employment for millions of people. However, among some problems, the sector suffers from declining biological resources and degraded aquatic habitats, impacting coastal and small-scale fishers who depend on local and regional ecosystems to derive their subsistence. Based on the concept of Shifting Baselines Syndrome, there are no adequate reference points for analysis of changes in fish composition, as subsidies for adequate management of fishery. Therefore, it is necessary to study historical and archaeological data with the objective of identifying change and spatial-temporal evolution of the species (e.g. overfishing). This study aimed to describe the ichthyofauna diversity in Brazilian pre-Columbian and to contribute to the development of ecological references, from the identification and measurement of faunistic remains in archaeological sites in Babitonga Bay for the purpose of comparison with information about the fisheries in the Brazilian coast.

Keywords: fishery, catch fisheries, Holocene, archaeology

SUMÁRIO

1 TEXTO INTEGRADOR

1.1 A RELEVÂNCIA SOCIOECONÔMICA DA PESCA ARTESANAL E SEU ESTADO DE CONSERVAÇÃO

A pesca artesanal contribui para a seguridade alimentar e a erradicação da pobreza ao proporcionar alimentos, renda, e emprego para milhões de pessoas (FAO, 2016, 2015). Na América Latina, a pesca artesanal é praticada em uma ampla gama de ecossistemas e integra conhecimento tradicional resultante de um longo e complexo processo de ocupação costeira. Os pescadores costeiros e de pequena escala possuem dependência destes ecossistemas locais e regionais onde desenvolvem seus meios de subsistência (SALAS et al., 2011). No entanto, entre vários problemas, o setor sofre com a diminuição dos recursos biológicos e a degradação dos habitats aquáticos. Esta realidade reforça a importância de compreender, avaliar e gerenciar de modo mais eficaz a pesca em seu todo (SALAS et al., 2011). Embora padrões gerais possam ser observados em toda a América Latina, a situação geral de cada país é resultado de diferentes especificidades. Desta forma, estudos específicos para compreensão de realidades distintas e seus desafios locais vêm sendo realizados em cada região (SALAS et al., 2011).

Um conceito que vem recebendo atenção na área ambiental desde o final do século XX, é a Síndrome de Mudanças de Linhas de Base (*Shifting Baseline Syndrome*) - uma linha de base descreve um ponto de partida utilizado para avaliar mudanças de aspecto espaço-temporal. Dentro da ecologia marinha, Pauly (1995) foi o primeiro cientista a usar o termo Shifting Baselines Syndrome, o qual, de acordo com autor, é uma mudança gradual da linha de base, uma acomodação do desaparecimento progressivo de espécies, e pontos de referências inadequados para avaliar perdas econômicas resultantes da sobrepesca ou para identificar alvos objetivando medidas de reabilitação (KLEIN; THURSTAN, 2016). Utilizando a pesca como exemplo, Pauly (1995) define que esta síndrome de mudanças de linha de base está ocorrendo porque cada geração de pesquisadores de pesca utiliza como base o estoque e a composição de espécies a partir do início de suas carreiras para avaliar a ocorrência de mudanças faunísticas (KLEIN; THURSTAN, 2016). Portanto, conforme este paradigma, as linhas de base naturais são redefinidas a cada nova geração (PAULY, 1995).

Assim, utilizar a Mudança de Linhas de Base é uma proposta necessária para o campo da ecologia, na qual a compreensão limitada de padrões de distribuição e abundância, cadeia alimentar e a estrutura da comunidade se baseia no pressuposto de que o importante é o que existe, uma vez que pode ser observado no momento presente (JACKSON; JACQUET, 2011). No âmbito ecológico, a linha de base pode envolver o uso de uma localização geográfica de referência para comparação de locais distintos no espaço. Outro campo de utilização da linha de base é a avaliação da modificação de um ecossistema ao longo do tempo, onde consequentemente o conhecimento pretérito se faz necessário (KLEIN; THURSTAN, 2016). Assim, estudos vêm sendo propostos e desenvolvidos com o objetivo de conhecer e compreender os registros prístinos, servindo de suporte para práticas que visem, por exemplo, a sustentabilidade e a revitalização de espécies impactadas por alterações ambientais naturais e antrópicas ao longo do tempo (SCHEEL-YBERT et al., 2009; LOPES et al., 2016; LIMA, 2000; ERLANDSON; RICK, 2008; MCKECHNIE et al., 2014).

Parcela significativa dos dados estatísticos atualmente em uso para a avaliação dos recursos pesqueiros, incluindo distribuição e abundância das espécies, recua somente a algumas décadas e não integra dados de pesca artesanal (PAULY; ZELLER, 2016). Curiosamente, sabemos por exemplo que a pesca no Brasil vem sendo praticada há pelo menos seis mil anos (WAGNER et al., 2011; GASPAR et al., 2008). Hoje estima-se que a maior parte da pesca artesanal no Brasil está em declínio ou em colapso (VASCONCELLOS et al., 2007), algumas das espécies encontra-se em perigo de extinção (IUCN, 2019; Brasil, 2018) ou experimentam uma diminuição no seus tamanho corporais (LOPES et al., 2016). Portanto, além de dados relativos à produção pesqueira, a biologia dos recursos, as práticas de pesca, e a aspectos socioeconômicos e culturais (SERAFINI et al., 2014), é necessário adotar também uma perspectiva de longo prazo temporal no levantamento de dados com a finalidade de manejo dos remanescentes da pesca artesanal atual, compilando assim dados referentes à atividade pré-histórica de pesca, informações que somente a arqueologia e a história podem fornecer (ERLANDSON; RICK, 2008).

1.2 SÍTIOS ARQUEOLÓGICOS DO LITORAL SUL DO BRASIL: ARQUIVOS INESTIMÁVEIS DE BIODIVERSIDADE MARINHA NO PASSADO

A pesca indígena no território brasileiro é uma atividade anterior à chegada dos europeus, já que peixes, moluscos e crustáceos faziam, de modo variável, parte da sua dieta (SOUZA, 1587; DIEGUES, 1999; COLONESE et al., 2014). Evidências arqueológicas de pescaria pré-colonial constelam o litoral brasileiro sob forma de concheiros, também chamados Sambaquis, e sítios arqueológicos rasos com restos abundantes de peixes, mamíferos marinhos e terrestres silvestres (PROUS, 1991). Tais evidências são particularmente bem conhecidas ao longo do litoral sul do Brasil, e encontram seu ápice no contexto ecológico da Mata Atlântica (GASPAR et al., 2008), um dos maiores repositórios de biodiversidade e, ao mesmo tempo, um dos mais ameaçados biomas do mundo (CAMPANILI; SCHAFFER, 2010; DIEGUES, 2002; PAGLIA et al., 2002). Os sítios arqueológicos do litoral da Mata Atlântica fornecem um extensivo conjunto de informações sobre os grupos humanos que os construíram, de seus perfis culturais (WAGNER et al., 2011), e contextos ambientais (e.g. LOPES et al., 2016). Os sambaquis são também os sítios arqueológicos de formação antrópica mais visíveis na paisagem litorânea (PROUS, 2007), resultantes do acúmulo progressivo e intencional de restos faunísticos, em particular remanescentes de moluscos e peixes, construídos por populações pré-históricas de pescadores-caçadores-coletores que se instalaram na costa por volta de 6.500 anos antes do presente (AP) (GASPAR, 2004). Em determinadas regiões do litoral do Estado de Santa Catarina, verificam-se sambaquis atingindo cerca de 30 metros de altura (COLONESE et al., 2014; WAGNER et al., 2011; LIMA, 2000). A presença destes monumentos pré-históricos evidencia a capacidade de grupos pré-coloniais na modificação da paisagem, e possivelmente até mesmo de impactar de modo negativo o seu meio ambiente. Ao se tratar de sítios arqueológicos em Santa Catarina, uma das localidades que ganha destaque pela grande quantidade de sítios e pelo interesse dos pesquisadores, é a Baía Babitonga, na região nordeste do Estado (OKUMURA; EGGERS, 2005; BANDEIRA, 2015).

1.3 ARQUEOLOGIA, RESTAURAÇÃO ECOLÓGICA E PESCA SUSTENTÁVEL: UM NOVO PARADIGMA PARA A ARQUEOLOGIA BRASILEIRA?

Estamos apenas começando a compreender as consequências ecológicas acerca do colapso e esgotamento de espécies, e da perda de habitats em ecossistemas marinhos costeiros e particularmente estuarinos, costões ou fundos rochosos, baías, lagoas marginais e praias arenosas , considerados como base fundamental da produtividade marinha que alimentou sociedades humanas há milhares de anos (ERLANDSON; RICK, 2008). Com base nesses argumentos, cientistas estão reivindicando mudanças fundamentais na gestão pesqueira em ecossistemas marinhos, incluindo análises históricas contemplando dados arqueológicos para a realização de planos mais eficazes de manejo pesqueiro, bem como esforços de políticas públicas para restauração de ecossistemas sustentáveis (BRAJE et al., 2017; ERLANDSON; RICK, 2008, JACKSON et al., 2001). Estudos em sítios costeiros têm muito a contribuir aos debates e às políticas públicas relacionadas com a conservação e restauração marinha, à gestão pesqueira e outras questões oceânicas cruciais. Neste princípio, os registros arqueológicos se tornam uma ferramenta possível para obtenção de dados pretéritos sobre espécies alvos, padrões de pesca, dimensão corporal dos indivíduos, métodos e artes de pesca pretéritas, com a possibilidade de aplicar este conhecimento na preservação das espécies nos dias de hoje. As pesquisas arqueológicas exclusivamente com material faunístico do litoral brasileiro, na Mata Atlântica, contaram com o pioneirismo de Bandeira (1992), cujo objetivo foi contribuir com detalhes sobre as estratégias de obtenção de alimento e debate a respeito de similaridade e diferenças nos horizontes sem cerâmica e com cerâmica dos sambaquis da Babitonga, a partir da fauna encontrada no Sambaqui Enseada I. Posteriormente, outros estudos foram desenvolvidos em sítios costeiros nas regiões sul e sudeste do Brasil (FIGUTI, 1993; KNEIP, 1994; FIGUTI; KLOKLER, 1996; BANDEIRA, 2004; MACHADO et al., 2011; VILLAGRAN et al., 2011; COSTA et al., 2012; BANDEIRA; SANTOS; KRASSOTA, 2013; RICKEN et al., 2014; SOUSA; FIGUEIREDO; BANDEIRA, 2014; RICKEN, 2015; PAVEI et al., 2015; RICKEN et al., 2016; LOPES et al., 2016; BANDEIRA et al., 2018; CARDOSO, 2018).

Os estudos acima mencionados registram espécies que viveram na costa brasileira entre 8.000 (abrigos sob-rochas de caçadores-coletores do RS) até cerca de 620 anos AP (Forte Marechal Luz na Baía Babitonga/SC). Inclusive, algumas se encontram hoje ameaçadas de extinção, conforme disposto na Instrução Normativa 05/2004 (BRASIL, 2004), nas portarias do Ministério do Meio Ambiente nº 444/2014 (BRASIL, 2014a) e nº 445/2014 (BRASIL, 2014b), e na lista vermelha da IUCN. Como mencionado por Erlandson e Rick (2008), as discussões a partir das perturbações humanas sobre a fauna são limitadas, quase que totalmente, às espécies de vertebrados terrestres, faltando estudos com espécies marinhas e aquáticas. Portanto, este estudo traz dados históricos únicos a respeito da fauna na costa da Mata Atlântica.

Esta dissertação está estruturada em dois capítulos em forma de artigos, conforme o Manual de Dissertações e Teses da UFSM. No primeiro artigo, intitulado "*Pre-Columbian fisheries catch reconstruction for a subtropical estuary in Southern America*", descrevemos a composição da arqueofauna do sambaqui Cubatão I, representada por 38 *taxa* correspondendo a 22 espécies, e a 19 famílias de peixes (Teleostei e Elasmobranchii), e a reconstrução de captura de pescadosem torno de 73.117,49 toneladas durante o período de ocupação estimado em aproximadamente 5690 anos, representando ± 12,9 t/ano^{-1} para o Holoceno médio e tardio na Baía Babitonga, um dos principais estuários do litoral meridional brasileiro (KNIE, 2002). A partir de coleção de referência e da literatura especializada, 5186 remanescentes da fauna do sambaqui Cubatão I foram recuperados das camadas 1 e 2, nas áreas A (3m^2), B (2.25m^2) e C (1m^2),. Para obter os dados da reconstrução de captura, por simples extrapolação, avaliamos e utilizamos o volume agregado de sítios na Baía Babitonga, e o mesmo valor de densidade de peixes (MNI/m^3) para os sítios da região, baseando-nos pelos resultados obtidos no Cubatão I, e pela similaridade de densidade com os outros sítios em que a arqueofauna foi estudada.

Cientes de que estudos da arqueozoologia com esta abordagem está ganhando reconhecimento global, e que a América do Sul recebeu pouca atenção até o presente momento (Costello et al. 2010, Engelhard et al. 2016, Burger 2016), buscou-se avaliar o histórico de estudos e dados da arqueofauna na Babitonga. No segundo artigo intitulado "Integrating zooarchaeology in the conservation of coastal-marine ecosystems in Brazil" realizamos um levantamento de publicações técnicas que caracterizam a composição dos remanescentes faunísticos no âmbito quali-quantitativo, com identificação ao menor nível taxonômico. Totalizamos 110 sítios com registro de arqueofauna no Holoceno na Baía Babitonga, e 244 espécies distribuídas em Annelida (1), Mollusca (Bivalvia, 67; Gastropoda, 59), Arthropoda (Malacostraca, 2; Hexanauplia, 2) e Chordata (Elasmobranchii, 14; Actinopterygii, 57; Reptilia, 4; Ave, 3; e Mammalia, 35) - os espécimes identificados nas categorias taxonômicas superiores foram contabilizados como uma espécie.

2 ARTIGO 1 – PRE-COLUMBIAN FISHERIES CATCH RECONSTRUCTION FOR A SUBTROPICAL ESTUARY IN SOUTHERN AMERICA

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Prehistoric fisheries catch in Brazil

Keywords: coastal archaeology, Brazilian Atlantic Forest, historical fisheries; middle and late Holocene, shell mound and middens, subsistence fisheries.

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Abstract: Small-scale fisheries provide food and livelihoods for thousands of people along the Brazilian coastline. However, considerable uncertainties still surround the extent to which artisanal and subsistence fisheries contribute to the total of national landings and their historical ecological significance. Fisheries monitoring is deficient in Brazil and historical records are limited to irregular accounts spanning the last few decades, while this coastline has supported human populations for at least 6000 years. Here, we estimate Pre-Columbian subsistence catches for a large subtropical estuary in southern Brazil. Our results suggest that prehistoric populations may have extracted volumes of fish biomass higher or comparable to historical subsistence fisheries in the region, and that the latter are likely underestimated. If a long-term perspective is required to evaluate the current economic value and status of fisheries in subtropical and tropical South America, this should go beyond the historical time interval and integrate the contribution of Pre-Columbian archaeology.

Introduction

Small-scale fisheries (artisanal and subsistence; Pauly & Zeller, 2015) are crucial sources of food and livelihoods for million people in Latin America (Salas, Chuenpagdee, Charles, & Seijo, 2011), many of which live in rural areas and use ecological knowledge that are deeply rooted in the past (Begossi et al., 2017; Diegues, 1997; Diegues, 2006; Silvano &

Begossi, 2012). Brazil has one the world's longest coastlines (ca. 7,491 km), with some of the most diverse biomes on earth (the Amazon and the Atlantic Forests), and a variety of human populations that depend on coastal ecosystems for food (Vasconcellos, Diegues, & Kalikoski, 2011). Small-scale fisheries currently account for ca. 50% of the total freshwater and marine landings in the country (Melo, Loes, Guariento, & Carvalho, 2015; Vasconcellos et al., 2011), but the numbers were higher (>80%) before fiscal incentives to the industrial sector became commonplace after 1967 (Diegues, 2006). Nevertheless, considerable uncertainties still surround the extent to which artisanal and subsistence fisheries exploited coastal resources in historical times, which prevents a full recognition of the status of local to regional marine ecosystems (Jackson et al., 2001; Pinnegar & Engelhard, 2008) as well as the economic and cultural sectors themselves (Elfes et al., 2014). Fisheries monitoring is historically deficient in this region, limited to irregular and geographically scattered statistics spanning the last few decades (Bender et al., 2014; Melo et al., 2015; Elfes et al., 2014; Freire & Pauly, 2010). Moreover, this coastline has supported human populations for at least 6000 years, through fishing, hunting and harvesting of estuarine and marine environments (Bastos et al., 2015; Colonese et al., 2014; Gaspar, 1998; Lima et al., 2004). Recent studies reveal that Pre-Columbian populations of the Atlantic Forest coastal zone potentially overexploited key taxonomic groups, causing a population decline (Lopes et al., 2016), but the scale of this exploitation remains a matter of debate.

Anthropogenic impact on marine ecosystems is unarguably one of the most pressing issues in marine conservation (Pinsky, Jensen, Ricard, & Palumbi, 2011; Roberts, 2010; Worm et al., 2009). There is a growing consensus that our understanding of this process is historically distorted (Pauly & Zeller, 2016), biased towards statistical records that fail to integrate a broad range of fishing practices (Pauly, 1995; Zeller & Pauly, 2018), and the legacy of longstanding human use of aquatic environments in most parts of the world (Jackson et al., 2001; Pinnegar & Engelhard, 2008). Fish and shellfish remains from archaeological contexts can offer valuable qualitative and quantitative information for reconstructing the scale of human exploitation of aquatic resources in the past, notably throughout prehistory (Erlandson & Rick, 2008; Jackson et al., 2001; Lotze & Worm, 2009; McKechnie et al., 2014; Plank, Allen, Nims, & Ladefoged, 2018). This is particularly true for South America, where historical records span the last 500 years. Yet there has been little attempt to integrate zooarchaeological research with contemporary debates in conservation biology in Brazil (Lopes et al., 2016; Silva, Pádua, Souza, & Duarte, 2017; Souza, Fernandes, & Silva, 2003; Souza, Lima, Duarte, & Silva, 2016).

Here, we report the results of the taxonomic analysis of fish remains from Cubatão I, an archaeological shell mound in Babitonga Bay (Santa Catarina State). The results demonstrate that numerous taxa were exploited, and provide snapshots of ecological niches used by coastal groups during a time interval of ca. 150 years, between ca. 2460-2310 and 2310-2090 cal BP. Babitonga Bay has the highest concentration of Pre-Columbian shell mounds and middens of the entire Brazilian coastline (>170 sites), many of which have been previously radiocarbon dated. Following recent catch reconstruction approaches (Freire et al., 2015; Pauly & Zeller, 2016; Zeller & Pauly, 2018), we used the density of fish remains from Cubatão I and the total volume of sites in this region to derive conservative estimates of minimum fish catches in Babitonga Bay over a period of ca. 6000 years. This approach, which conceptually does not differ from generic estimates used on modern fisheries statistics (Orton, Morris, & Pipe, 2017; Stamatopoulos, 2002), reveals annual Pre-Columbian fisheries catches similar or higher than local historical estimates for subsistence fisheries of the second half of the 20th century. Our results suggest that the widely overlooked historical subsistence fisheries catches along the Brazilian coastline since 1950s are likely underestimated.

1.2. Pre-Columbian coastal exploitation in Babitonga Bay

Babitonga Bay (ca. 130 km²), on the northeast coast of Santa Catarina state (26º 07’W and 26º 27’S), drains an area of ca. 1.567 km² (Vieira, Horn-Filho, Custodio-Bonetti, & Bonetti, 2008), and is surrounded by dense subtropical forests, restinga vegetation and the highest mangrove ecosystem in southern Brazil (Gerhardinger et al., 2018; Knie, 2002; Vieira et al., 2008). Hundreds of archaeological shell mounds and middens, also known as *sambaquis*, have been recorded in Babitonga Bay. As for other sites along the Brazilian coast, the shell mounds and middens in Babitonga Bay are associated with sedentary or semi-sedentary foragers and horticulturalists that exploited a variety of fish and shellfish in the context of everyday lifeways and mortuary practices (e.g. funerary feasting) since at least 6000 years ago (DeBlasis, Fish, Gaspar, & Fish, 1998; Gaspar, DeBlasis, Fish, & Fish, 2008; Souza et al., 2016; Wagner et al., 2011). Fish, in particular, was the prevailing source of dietary protein at several sites dated from the Middle to Late Holocene (Bastos, Lessa, Rodrigues-Carvalho, Tykot, & Santos, 2014; Pezo-Lanfranco et al., 2018). Babitonga Bay witnesses the introduction of ceramics at ca. 1,500 cal BP by groups associated with the ceramic tradition *Taquara/Itararé*. This time interval coincided with the widespread use of domestic crops (Wesolowski, Souza, Reinhard, & Ceccantini, 2010), but faunal remains (Bandeira, 1992; Bandeira, 2004) and bone collagen stable isotope analyses (Bastos et al., 2014; Pezo-Lanfranco et al., 2018) indisputably demonstrate that aquatic resources continued to be the dominant source of dietary protein. The longstanding history of subsistence fishing persisted in the area with the European colonisation and urbanisation of Babitonga Bay, which nowadays is home to several artisanal fishing guilds (*Colônias de pesca*), some of which are in areas previously occupied by *sambaquis* (Fig. 1B).

Cubatão I, located in a tributary of the Palmital River, is ca. 10 m high by ca. 80 m in length, and has been the subject of systematic archaeological excavations between 2007 and 2009 (Bandeira, Oliveira, & Santos, 2009; Figuti, 2009; Venera & Severino, 2010) (Fig. 1B-E). Excavations on the upper sector of the site (ca. 54.7 m²) encountered two main archaeological deposits: Deposit 1 was ca. 20-30 cm deep and contained both prehistoric and historical remains, and Deposit 2 was an underlying sedimentary context rich in bivalve shells (notably *Anomalocardia flexuosa*), vertebrate faunal remains, artefacts (stone and bone tools) and numerous human burials (n = 23 individuals). Deposit 2 was excavated to a depth of ca. 80 cm and has been radiocarbon dated from ca. 2430 ± 40 to 2660 ± 40 yr BP (Supplementary information 1). More recently, fluvial erosion due to changes in land management, has progressively affected the NE perimeter of the site exposing a stratigraphic sequence of ca. 8 m (Fig. 1E). At the base of the sequence, several well-preserved plant artefacts were found in waterlogged conditions, including baskets, nets, ropes, knots made of aerial roots of *Philodendron* sp. (Peixe, Melo Jr, & Bandeira, 2007; Sá, 2015) and wooden artefacts made from a variety of taxa (Melo Jr, Silveira, & Bandeira, 2016). The lowermost sedimentary record in the exposed stratigraphic sequence (lower sector) has been radiocarbon dated between ca. 2975 ± 30 and 3110 ± 70 yr BP. Archaeological deposits at the perimeter of the site are relatively contemporaneous with the dated plant remains, with radiocarbon dates ranging from ca. 2890 ± 70 to 3480 ± 60 yr BP.

2. Materials and methods

2.1. Chronological model for the Pre-Columbian occupation of Babitonga Bay

The time and duration of Pre-Columbian occupation of Cubatão I and the whole Babitonga Bay was modelled using 106 radiocarbon dates (^{14}C) assembled from the literature, generated on a range of archaeological materials (marine shells, human and faunal bones, and charcoal, Supplementary information 1 and 2). The radiocarbon dates were calibrated (BP) using OxCal v. 4.3 (Ramsey, 2009). Charcoal samples were calibrated using the 100% atmospheric calibration curve for the southern hemisphere, SHCal13 (Hogg et al., 2013); shells were calibrated using the 100% Marine13 curve (Reimer et al., 2013), applying an estimated average local marine radiocarbon reservoir correction value (ΔR) of 23 ± 52 according to (Angulo, Souza, Reimer, & Sasaoka, 2008; http://calib.org/marine/). Radiocarbon dates on human bone collagen samples were calibrated using a combination of the marine (Marine13) and terrestrial curves (SHCal13), taking into account the relative contribution of marine carbon to collagen according to Pezo-Lanfranco et al. (2018) and the same ΔR value reported above. A threshold of 60% (agreement index, A_{model}) was used to assess the agreement between the calibrated (likelihoods) and modelled dates (probability distributions) (Ramsey, 1995, 2009). A single uniform phase of all calibrated dates for Babitonga Bay was used to summarise the marginal probability distributions (SPD; Ramsey, 2017).

2.2. Fish assemblage and relative abundance

Faunal remains were recovered from Deposits 1 and 2, in areas A (3 m²), B (2.3 m²) and C (1 m²) (Fig. 1D), from bulk sediments via dry and wet sieving over a 1 and 0.5 cm mesh (Figuti, 2009). Area A and B contained several human burials, the fills of which were analysed for their associate fauna. These included burial 9, an adult male (area A); burial 2, a child whose sex could not be determined; burial 5, an adult woman; burial 11, an old woman in area B (Figuti, 2009). Some of the recovered faunal remains from these deposits may be associated with mortuary practices (Klokler, 2014b).

The faunal remains were identified through side-by-side comparison with the reference collections house at the *Museu Arqueológico de Sambaqui de Joinville* and via specialised literature (Helfman, Collette, Facey, & Bowen, 2009; Homberger & Walker, 1994;

Lagler, Bardach, Miller, & Dora, 1977; Lepiksaar, 1994; Liem, 2001; Moyle & Cech, 2004; Radu, 2005). The nomenclature followed the World Register of Marine Species (Horton et al. 2019; http://www.marinespecies.org/index.php), while the ecological and trophic level attributions were obtained via FishBase (Froese & Pauly, 2019; http://www.fishbase.org/). Both fish and mammal remains were quantified by the number of identified specimens (NISP) and minimum number of individuals (MNI). The identifications were based on a combination of cranial and postcranial elements such as lower and upper jaws (articular, dentary, and premaxilla), olfactory region (prevomer), mandibular arches (quadrate), orbital or otic regions (cranial fragments), occipital region, cranial appendix (otolith), pectoral and fin skeleton, mesethmoid and caudal vertebrae. Considering the problems of quantifying elasmobranchs, a minimum number of 60 vertebrae of elasmobranch per individual was considered (Rick, Erlandson, Glassow, & Moss, 2002), and in the case of rays, their teeth plate (Berkovitz & Shellis, 2017) were used to calculate the MNI. Fish density values (MNI/m^3), a proxy for deposition and consumption rate, were estimated for all three areas. Taphonomical features such as fragmentation, exposure to heat and butchering marks were also recorded. The faunal remains were quantified and registered in the software Archaeobones version 2.2 (Ricken, 2015; Ricken, Silva, & Malabarba, 2012). Shannon diversity index (H) was used to explore taxonomic diversity using the abundance and evenness of taxa within archaeological spits. Correspondence Analysis (CA) was employed to infer exploited habitats and environmental condiions from taxonomic composition, abundance and frequency of fish remains through the stratigraphy of areas A, B and C. Statistical analyses were performed using PAST 3.06 (Hammer, Harper, & Ryan, 2001) and C2 data analysis 1.4.2 (Juggins, 2007).

2.3. Estimating catches

A bottom-up approach was used to derive the total catches (t) for the Pre-Columbian fisheries in Babitonga Bay. First, the minimum fish density value for Cubatão I (MNI/m^3) was adopted as a reference for extrapolating values from other sites. This assumption is supported by previous studies obtaining similar density values from other sites in Babitonga Bay (see below). Two methods were then used to convert the MNI/m^3 to fish wet-weight/m^3: (1) archaeological otolith metrics (Supplementary information 1), and (2) a modern survey of fish populations in Babitonga Bay.

First, complete whitemouth croaker (*Micropogonias furnieri*) otoliths (right/left MNI = 37), from areas A, B and C, were measured to estimate their maximum lengths (OL) according to previous studies (Bervian, Fontoura, & Haimovici, 2006; Lopes et al., 2016; Waessle, Lasta, & Favero, 2003). Otoliths were measured using a Zeiss Stemi 200 magnifier with a Dino-Eye coupled camera, and DinoCapture software (University of the Region of Joinville). Some specimens (>13 mm) were measured with a digital caliper, and then cross-calibrated with the above stereomicroscope. Individual OL values were converted into total fish lengths (T. Length) using the following equation reported in Lopes et al. (2016):

(Eq. 1) T. Length (mm) = 24.342 + 22.570 OL (mm) (r = 0.98; n = 93)

Modern otoliths (n = 31) from the teleostean fish otoliths collection of the Oceanographic Institute of the University of São Paulo (Rossi-Wongtschowski et al., 2016) were also measured to derive the relationship between OL and fish wet-weight. Otoliths were measured using a Zeiss Discovery V12 magnifier coupled with an AxioCam camera, and the AxioVision 4.8 software calibrated for individual measurements and a digital caliper. Some specimens (>11 mm) were measured with a digital caliper, and then cross-calibrated with the above stereomicroscope. The OL (mm) and fish wet-weight (g) of modern otoliths show a strong covariation (98% of variance) that is better explained as a potential regression model (Eq. 2):

(Eq. 2) Mass (g) = 0.1011OL (mm)3.0422 (R2 = 0.98; n = 31)

Eq 2 is statistically similar (p = 0.468, t = 0.8388) to regressions reported for whitemouth croaker from estuaries in southern South America (Waessle et al., 2003). The maximum total length of archaeological whitemouth croaker at Cubatão I corresponded to an average fish wet-weight of 334 ± 289 g.

The otolith metric based-estimates was in good agreement with the average fish wet-weight reported by Santos (2009) for Babitonga Bay. Santos reported an average value of 232 ± 1361 g, obtained from a variety of Actinopterygii (n = 74) and Elasmobranchii (n = 2) captured by bottom trawling during two months of each season of the year, so seasonal changes in fish productivity and spawning are factored into the average value. The survey-based value was then used for each individual specimen (MNI) from Cubatão I as the minimum average wet-weight.

The volume (Vm3) of 127 sites was then calculated using the following equation for spherical cap:

$$\text{(Eq. 3)} \quad Vm3 = 1/6\pi h(3r2 + h2)$$

where h corresponds to height and r, the estimated radius at the base of the site (Supplementary information 1).

The aggregated fisheries catches for all the sites was then estimated according to a generic formula:

$$\text{(Eq. 4)} \quad \text{Catch (t)} = \text{fish wet-weight/m}^3 * \text{aggregated volume of sites (m}^3\text{)}$$

Finally, the results were compared with estimated historical subsistence catches (t/years^{-1}) for the coast of Santa Catarina state, based on non-monetary/commercial marine fish acquisition as reported by Freire et al. (2015):

$$\text{(Eq. 5)} \quad \text{Total consumption (freshwater and marine)} = \text{number of registered fishers} * \text{fecundity rate (+2)} * \text{consumption per capita}$$

and

$$\text{(Eq. 6)} \quad \text{Subsistence catch (marine)} = \text{total consumption} * \text{proportion of non-commercial 'fish' acquisition}$$

where (+2) represents a fisher and the partner.

The number of officially registered fishers (professional and artisanal) was obtained for the period from 1950 to 1969 (IBGE 1950-1971) when the majority of fishing along the Brazilian coast was small-scale in nature (Diegues, 2006). The reproductive fecundity rate by decade for the region (south) was used to estimate the number of individuals by family as reported in Freire et al. (2015) for 1950 (5.7) and 1960 (5.9). Consumption *per capita* (3.1 kg/ year^{-1}) was also taken from Freire et al. (2015) for this time interval. For the proportion of non-commercial fish we considered the percentage of marine fish obtained through donation, removal from the business or own production, using data from 2002 (23.3% of non-commercial marine fish) for southern Brazil reported by the Household Budget Survey (*Pesquisa de Orçamentos Familiares*, IBGE) (Supplementary information 1).

3. Results

3.1. Age and duration of pre-Columbian fisheries at Babitonga Bay

The Bayesian model for Cubatão I showed good agreement with the spatial and stratigraphic expectation of the dates (A_{model} 65.8; Fig. 2) and placed the earliest phase of the site (lower sector) between ca. 3520-3070 and 3170-2730 cal BP (95% probability). The chronological interval of the excavated fraction of Deposit 2 (upper sector) was modelled between ca. 2460-2310 and 2310-2090 cal BP (95% probability), with an estimated median duration of 150 years for this deposit. The apparent chronological gap between the lower and upper phases is possibly due to a lack of radiocarbon dates for the stratigraphic deposits connecting both sectors; there is no evidence for a hiatus in occupation. The model estimates that Cubatão I was formed over an interval of ca. 740-1330 (95% probability) years, and most likely ca. 910-1160 (68% probability) years, with a median of ca. 1040 years. During this interval the site reached a volume of ca. 29,009 m^3, which conservatively corresponds to a median accumulation rate of ca. 27.9 m^3/year^{-1}.

The chronological model for Babitonga Bay produced a good agreement with the distribution of radiocarbon dates by site (A_{model} 102.6), placing the start of Pre-Columbian fisheries in the region of ca. 6530-6140 cal BP (95% probability). From this time, numerous *sambaquis* were formed along the estuary and the adjacent costal area until ca. 730-500 cal BP (95% probability), corresponding with a time interval of ca. 5690 years (median). The model also reveals that *sambaquis* and ceramic producing groups cohabited the region for a period of ca. 670-1170 years (95% probability). The earliest evidence of *Taquara/Itararé* ceramics was chronologically modelled to ca. 1770-1350 cal BP (95% probability), and extended until ca. 620-200 cal BP (95% probability). The median estimate for duration of the

Pre-Columbian coastal occupation at Babitonga Bay was ca. 5850 years, during which a variety of sites ranging from ca. 7 m^3 to 400,868 m^3 were formed, corresponding to an aggregated volume of ca. 3,252,673 m^3 (Fig. 3).

3.2. Fish remains from Cubatão I

A total of 5186 faunal remains were analysed from areas A, B and C (Fig. 4A-C), as well as the fills from the inhumation burials of 2, 9, 5 and 11. Of these, 99.8% of the remains were identified as fish with the remainder (0.2%) corresponding to terrestrial mammals (Supplementary information 3). The fish remains were dominated by postcranial elements with few diagnostic traits (67.7%), followed by cranial (22.6%) and undetermined fragments (9.7%). Therefore, the majority of the remains could not be identified beyond the class/sub-class level (e.g. Actinopterygii, 60%). Moreover, the lack of a complete reference collection coupled with the high fish diversity in this region (Reis et al., 2016) made identifications of postcranial elements problematic. Nevertheless, a total of 38 taxa indicating a minimum of 22 species and 19 families of fish were identified. Terrestrial mammals were scarcely represented by phalanges of Tayassuidae (NISP = 6) and incisors of rodents (NISP = 2), all recovered from the superficial Deposit 1.

A total of 4994 specimens were recovered from areas A (NISP = 1308), B (NISP = 2029) and C (NISP = 1657), of which 1332 were found in deposits containing human burials in areas A (burial 9, NISP = 272), and B (burial 5, NISP = 445; burial 11, NISP = 322; burial 2, NISP = 293). A further 192 specimens were directly associated with burials 11 (NISP = 183) and 9 (NISP = 9), but they lacked stratigraphic control. In the three areas the majority of the identified fish belonged to Ariidae (catfishes; up to 37% area B), Tetraodontidae (pufferfishes; up to 25%, area C) and Sciaenidae (drums, croakers; up to 17%); the remainder (21%) could not be identified to the species or genus levels. Fish density values (MNI/m^3) were 97 for area A, 167 for area B and 471 for area C. Previous studies in sites in Babitonga Bay (i.e. at Enseada I, Bupeva II and Itacoara) have obtained similar fish density values to those of area A (Bandeira, 1992; Bandeira, 2004).

Identifiable faunal remains from burials 2, 5, 9, 11 were dominated by Ariidae (15% NISP), Perciformes (7% NISP), and others (Supplementary information 3). In general, trophic level values were similar between areas A, B and C and human burials, ranging from 2.0

(Mugilidae, grey mullets) to a maximum of 4.9 (Chondrichthyes), without substantial changes throughout the stratigraphy. However, both areas A and B show stratigraphic differences in the abundance and density values, as well as in the taxonomic composition of the fish assemblages that roughly corresponded with funerary events. For example, in both areas there was a decrease in the abundance of Ariidae from the bottom to the uppermost part of Deposit 2, which corresponded with an increase of Tetraodontidae, Myliobatidae (sting rays) and Chondrichthyes. In Area A, burial 9 was identified from spit 8 to 4 (in stratigraphic order), where a decrease in fish abundance was observed (Fig. 4A). In area B, burial 11 was found between spits 12 and 11, while burial 2 and burial 5 were recovered in the above spits, 9 to 5 and 10 to 6 respectively (Fig. 4B).

3.3. Pre-Columbian catches

Considering the minimum fish density value at Cubatão I (ca. 97/m³; area A), the total volume of the site could be converted to a minimum total catch of ca. 652.10 t over ca. 1040 years, which represents ca. 0.63 t/year^{-1}. By simple extrapolation on the aggregate volume of sites in Babitonga Bay (ca. 3,252,673 m³), the same fish density value offers a total estimated catch of ca. 73,117.49 t over ca. 5850 years, representing ca. 12.5 t/year^{-1}. The summed probability distribution (SPD) of all calibrated radiocarbon dates from Babitonga Bay is highly irregular (Fig. 5). This suggests that deposition at the sites - and hence estimated catch - may have varied considerably over time, although fluctuations are also likely to reflect sampling and taphonomic biases, as well as the shape of the calibration curve (Contreras & Meadows, 2014; Ramsey, 2017; Rick, 1987).

4. Discussion

4.1. Fish remains from Cubatão I

Vertebrate faunal remains from Cubatão I were heavily dominated by fish and included a variety of taxa, many of which are nowadays widespread and relatively abundant in the region (Gerhardinger, Herbst, Cunha, & Costa, in press). Terrestrial resources, by contrast, were scarcely represented at the site, but have been identified in other assemblages from contemporaneous shell mounds and middens in the region (e.g. Enseada I, Bupeva II; Bandeira, 1992; Bandeira, 2004). However this is not a generalised pattern, with some Late

Holocene sites containing a relatively higher abundance of large terrestrial mammals (Bandeira, 2004; Bryan, 1993). This appears to be the case for sites with ceramic artefacts and may reflect changes in cultural preferences (Bastos et al., 2014). However, this is the time when the submerged seafloor became progressively exposed and drylands expanded with a regional decrease of sea level stand (Angulo, Lessa, & Souza, 2006; Behling & Negrelle, 2001; França et al., 2013), which may have favoured encounter rates with large mammals at closer distances to coastal localities.

Despite variations in food procurement strategies, zooarchaeology and bone collagen stable isotope analysis indisputably reveal that aquatic resources were the prevailing source of dietary protein and, in most cases, also calories in Babitonga Bay (Bastos et al., 2014; Pezo-Lanfranco et al., 2018). Our results indicate that fish at Cubatão I were possibly obtained through generalised fishing strategies throughout the year from shallow marine, brackish and freshwater environments (i.e. Arridae, Tetraodontidae and Sciaenidae, *Rhamdia* spp. and Loricariidae; Fischer, Pereira, & Vieira, 2011; Shipp, 2002). These taxa might have been captured using nets, spears and potentially traps, as supported by the presence of plant artefacts and bone points at the site (Peixe et al., 2007). It is unclear whether hooks were used asthe earliest evidence in the region is dated to ca. 2300 cal BP (Bandeira, 2004).

Previous studies on *sambaquis* in the Babitonga Bay region similarly demonstrate a generalised fishing strategy that was adapted to the local environment. Sites overlooking the open sea (i.e. Enseada I and Bupeva II) have a higher frequency of largehead hairtail (*Trichiurus lepturus*) and barred grunt (*Conodon nobilis*; Bandeira, 1992; Bandeira, 2004), while sites along the main estuarine channel (i.e. Forte Marechal Luz) and at the bottom of the bay (i.e. Espinheiros II) show a higher incidence of pufferfishes (*Lagocephalus laevigatus*) and whitemouth croaker (*Micropogonias furnieri*; Bryan, 1993; Figuti & Klokler, 1996). Finally, fluvial sites (i.e. Itacoara) were dominated by catfishes (Ariidae and *Rhamdia* spp.) and trahira (*Hoplias* sp.; Bandeira, 2004).

The spatial distribution of sites, which are generally organised in clusters of large mounds surrounded by smaller satellite sites in relatively distinct ecological zones, may be associated with the emergence of discrete communities, perhaps organised around central sites with prominent political and symbolic connotations (Fig. 1C; DeBlasis, Kneip, Scheel-Ybert, Giannini, & Gaspar, 2007). These sites would materialise community identities and territoriality, possibly through the cult of ancestors (DeBlasis et al., 1998; Gaspar et al., 2008). Beyond their nutritional importance, fish and other aquatic organisms would have played a central role in a community's religion, as supported by the deposition of fish in funerary contexts (Cardoso, 2018; Klokler, 2014a, 2016a). Fish used in funerary feasts could explain the stratigraphic differences in the taxonomic composition, abundance and density values in areas A and B (Dietler, 2011; Klokler, 2014b; Rowley-Conwy, 2018).

4.2. Pre-Columbian catches

Our estimates suggest that Pre-Columbian groups in Babitonga Bay exploited a minimum of ca. 73,117.49 t of fish over ca. 6000 years, or ca. 12.5 t/year^{-1}. As for other historical reconstructions and contemporary fisheries statistics (Engelhard et al., 2016; Zeller & Pauly, 2018), our estimates are based on a number of assumptions, and are inevitably affected by sampling and taphonomic biases. It assumes that the minimum density value at Cubatão I (97 MNI/m^3; 22.5 kg/m^3) can be conservatively expected for all sites in Babitonga Bay. This assumption is supported by similar density values reported for other sites in the region (Bandeira, 1992; Bandeira, 2004). It is worth noting that higher density values were recorded at Cubatão I (Area B and C), and others have estimated higher fish density values for *sambaquis* in southern Brazil. For example, at the site of Jabuticabeira II, Klokler (2008) estimated fish density values ranging from 1000 to 16000 MNI/m^3, corresponding to fish wet-weight/m^3 ranging from 13.2 to 1267 kg/m^3. Using otolith metrics she estimated fish wet-weight/m^3 ranging from ca. 112 to 275 kg/m^3. These figures are significantly higher than the conservative value used in this study. Equally important, we assume that variations in the composition of fish at some sites in Babitonga Bay has no impact on the average wet-weight of fish. This is substantiated by otolith metric data from Cubatão I, as well as from other sites along the Atlantic Forest coast containing captures with average wet-weight much larger than the average used in our reconstructions (Klokler, 2016b; Lopes et al., 2016). One must also consider that our estimates are limited to visible and relatively well-preserved sites that survived the widespread historical exploitation of *sambaquis* for lime production until the late 1960's (the number of demolished sites is currently unknown). Many sites used in this study have been partially destroyed since historical times (Oliveira, 2000), and possibly suffered post-deposition physical deformations typically observed in shell mounds and middens

(Holdaway et al., 2017). Consequently, the original volume of sites must have been higher in the past. Finally, it is reasonable to assume that fish were also consumed and discarded elsewhere, in contexts that are absent in our records (e.g. acquisition and residential sites). We are therefore confident that our estimates are highly conservative and represent minimum values of catches.

Considering the average value of consumed fish per capita (74 kg/year^{-1}) recently reported for coastal indigenous populations around the world (Cisneros-Montemayor, Pauly, Weatherdon, & Ota, 2016), our estimates equate to an average number of ca. 988,074.19 people in the region over ca. 6000 years, or ca. 168,90 people/year^{-1}. These numbers are almost certainly underestimated and the overall population may have been much higher as implied by other lines of evidence (Fish, DeBlasis, Gaspar, & Fish, 2000; V. Wesolowski & Neves, 2002). Nevertheless, these groups depended on fish as their main source of food for thousands of years, and consumed levels of marine protein that are well above values currently reported for the Brazilian population (Diegues, 2006). Regular captures of fish for their nutritional, social and cultural values by numerous stationary groups in this region may ultimately have had ecological implications, as recently reported in other areas along the Brazilian coast (Lopes et al., 2016). Interestingly, the estimated annual catch for Babitonga Bay is just below the reconstructed subsistence catches for the Santa Catarina state in the 1950-1960s (representing 70% to 6%), but the number of officially registered fishers in Babitonga Bay corresponds to ca. 9.2% of the total registered fishers in the Santa Catarina state (*Projeto de Caracterização Socioeconômica da Atividade de Pesca e Aquicultura* - PCSPA, available at: http://pmap-sc.acad.univali.br/index.html). By adjusting for this difference, the estimated annual Pre-Columbian catches are higher than historical estimates between 1950 and 1964, when most of the fisheries were small-scale in nature (Fig. 6). This may indicate that historical subsistence catches along the Brazilian coast (Freire et al., 2015) are underestimated, therefore their historical socio-economic value and ecological significance remains unclear.

5. Conclusion

Our attempt to estimate Pre-Columbian subsistence catches for a large estuarine site and surrounding environment along the subtropical Atlantic Forest coast reveals that prehistoric populations may have extracted volumes of fish higher than or comparable to reconstructed historical subsistence fisheries in the region. Small-scale fisheries may provide a higher contribution to landings than conventionally reported in national statistics, thus unreliable estimations may adversely impact fisheries management and marine conservation efforts. The perception that substantial fish catches along the Brazilian coastline are primarily the outcome of recent decades (or centuries) of technological development and market oriented economies, ignores thousands of years of human interaction with coastal and marine ecosystems in this region. A thorough recognition of the socio-economic and ecological importance of small-scale fisheries along the Atlantic Forest coastline of Brazil thus requires an understanding of the scale of human use of marine resources that transcends historical records. This information can be potentially extracted from Pre-Columbian shell mounds and middens locally known as *sambaquis*.

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Figure captions

Figure 1. (A) Location of Babitonga Bay in southern Brazil; (B) location of Cubatão I along with other shell mounds and middens, and modern artisanal fishing guilds (*Colônias de pesca*) in Babitonga Bay; (C) heat map of volume of sites (m^3) showing site clusters, which may represent fishing communities; (D) overview of Cubatão I showing the upper sector and specific areas (A, B and C) that were analysed in this study, and (E) lower sector, showing the erosion of the archaeological deposits by fluvial activity. Yellow stars represent areas where radiocarbon dates in the lower sector were obtained.

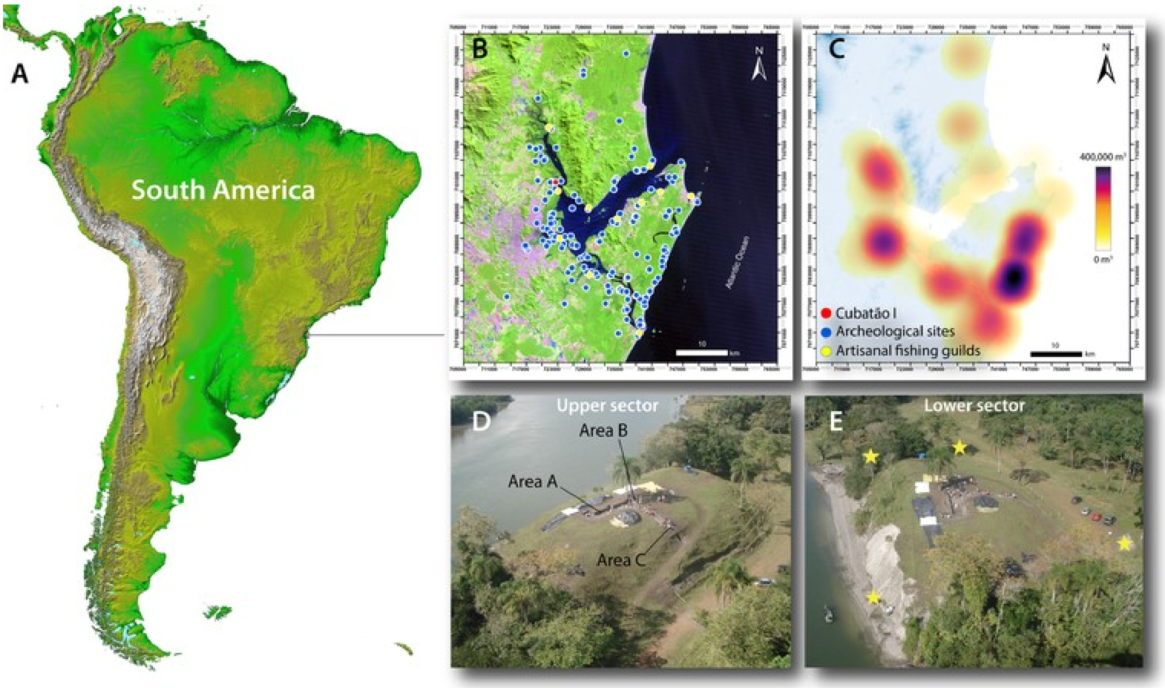


Figure 2. Probability distributions of radiocarbon dates from the lower and upper sectors of Cubatão I.

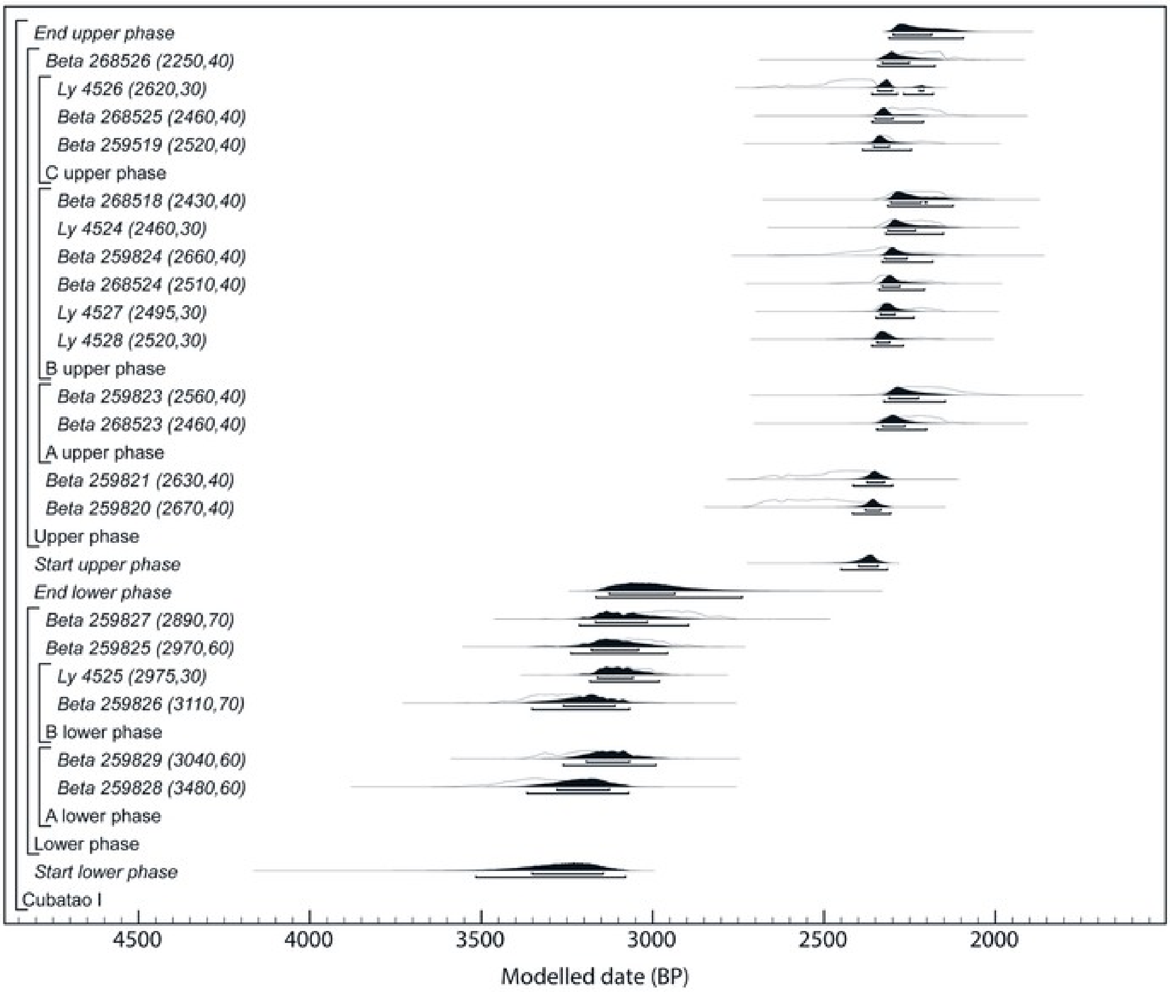


Figure 3. Estimated volume of Pre-Columbian shell mounds and middens in Babitonga Bay.

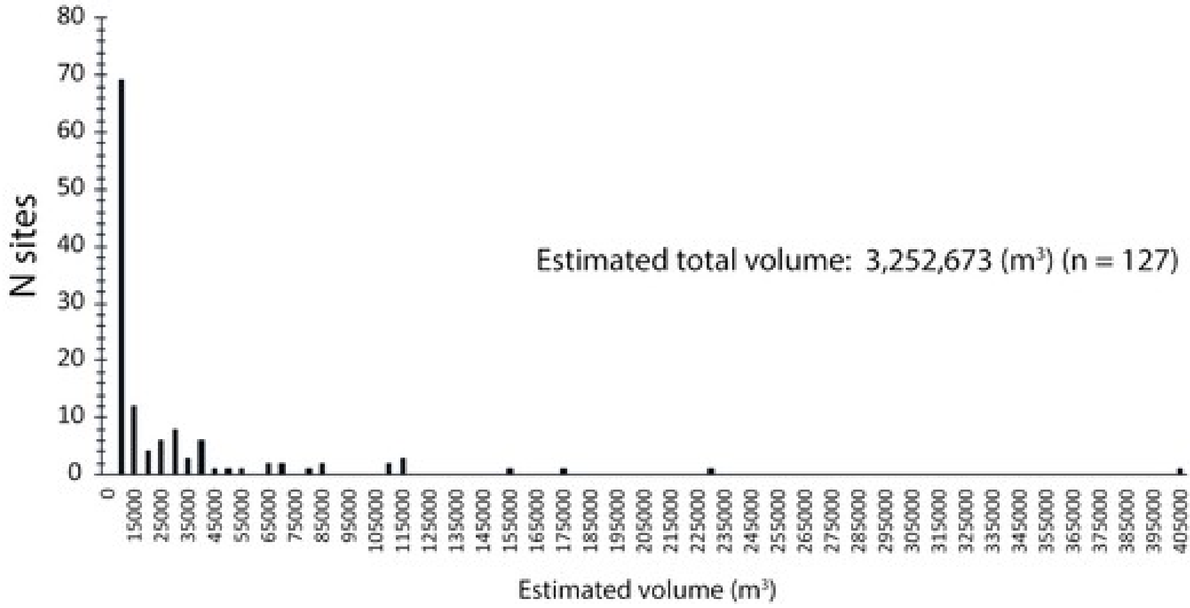


Figure 4. Relative abundance of marine and terrestrial faunal remains*, including their density for the volume of sediment, species diversity and the environmental gradient represented by first axis of the correspondence analysis for areas A, B and C. The green bands indicate the stratigraphic position of human burials in the areas.

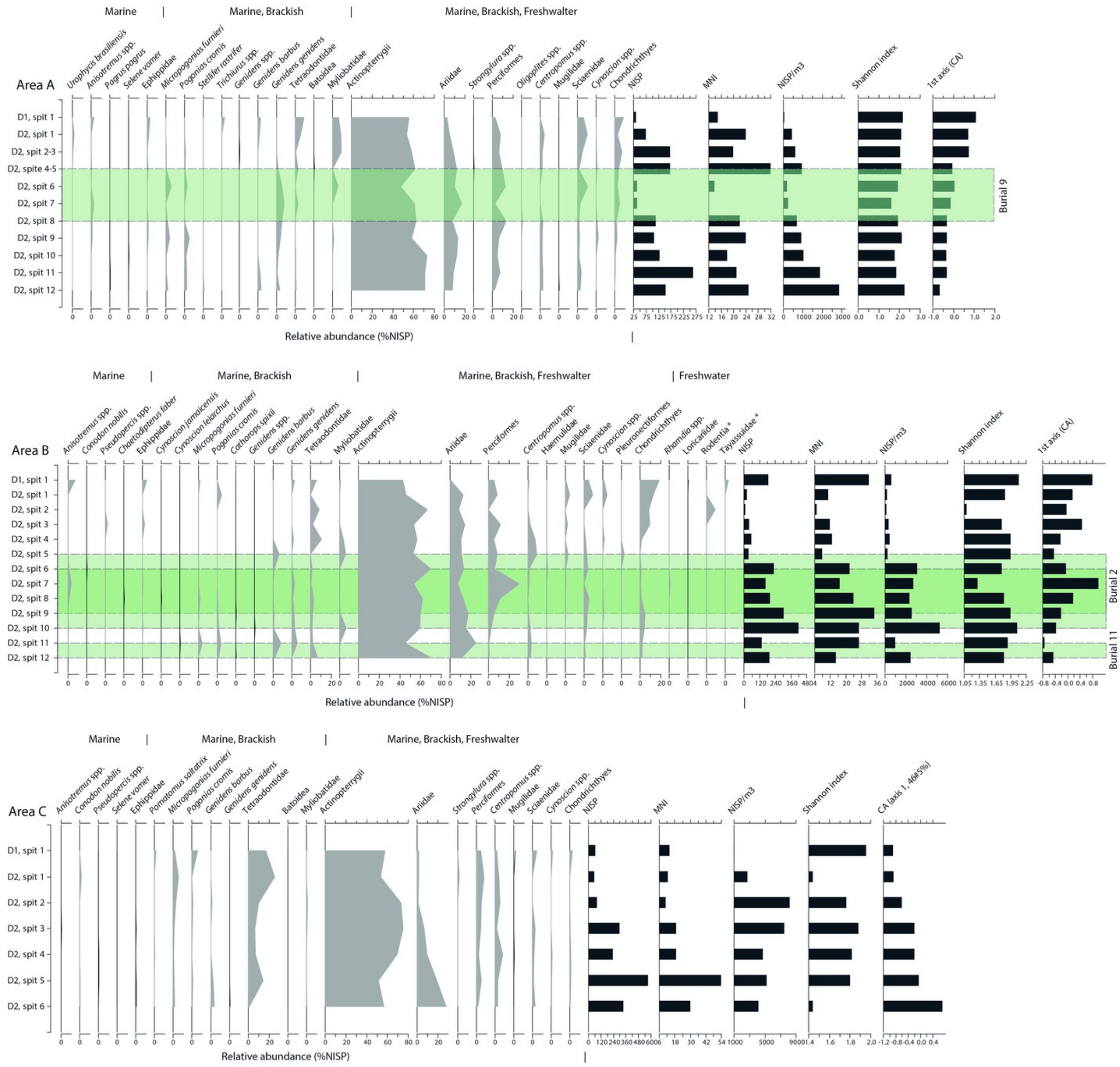


Figure 5. SPD of single uniform phase of calibrated dates from Babitonga Bay. The black cross represents the medians of the posterior distribution for each date.

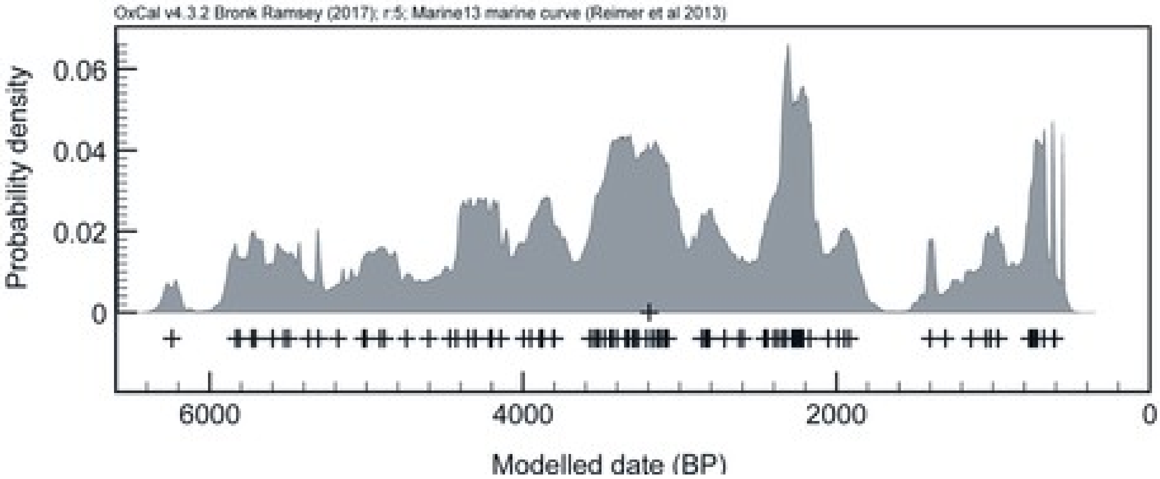
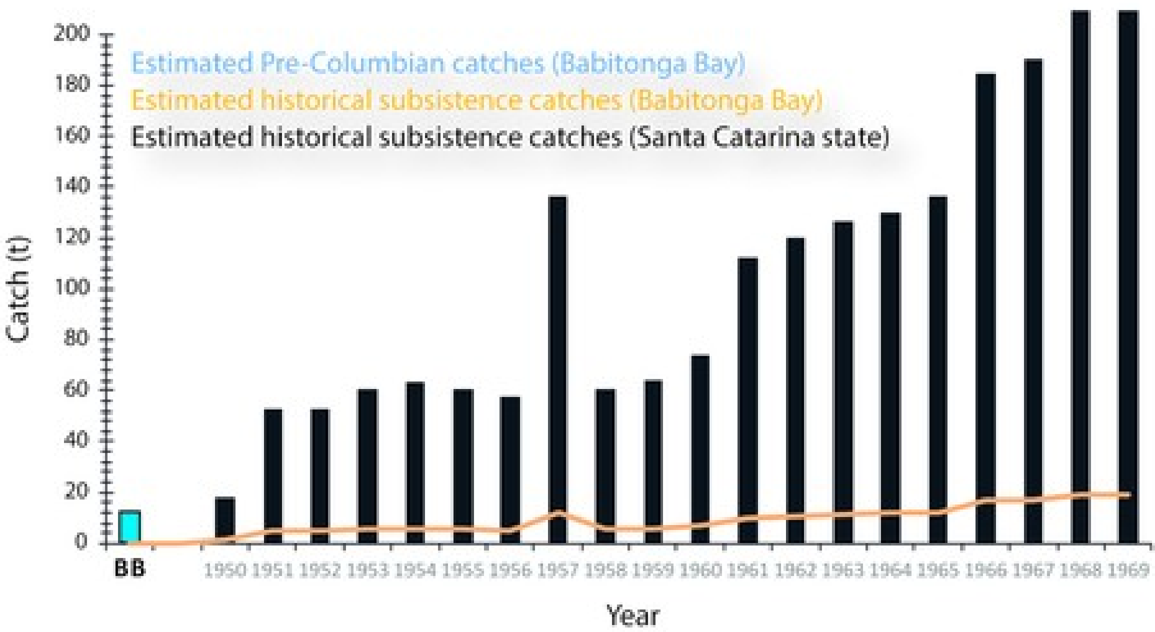


Figure 6. Annual subsistence catches from non-monetary acquisition based on household budgets for the Santa Catarina state and Babitonga Bay, along with the reconstructed annual Pre-Columbian catches for Babitonga Bay (BB).



Authorship

TF, **ACC**, **DB** designed the study, analysed and interpreted data, wrote the manuscript; **JF**, analysed data; **LF**, provided data, critically reviewed the manuscript; **SD**, critically reviewed the manuscript; **NH**, analysed data; **HKR**, **DO**, critically reviewed the manuscript. All authors gave approval on the version submitted for publication.

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Data Availability Statement

Data used in this paper is available or can be generated with the information in Supplementary information 1, 2 and 3.

3 ARTIGO 2 – INTEGRATING ZOOARCHAEOLOGY IN THE CONSERVATION OF COASTAL-MARINE ECOSYSTEMS IN BRAZIL

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Abstract:
Sambaquis are archaeological shell mounds and middens formed by pre-Columbian populations inhabiting the Atlantic Forest coast of Brazil between the Middle and Late Holocene. Beyond their recognized cultural values, sambaquis are valuable biological archives for tracking changes in past biodiversity and informing modern conservation studies and management. In this contribution we reviewed the published record of faunal remains from archaeological sites located in Babitonga Bay, in the state of Santa Catarina, southern Brazil. Through a literature review covering 110 sites, we assembled a comprehensive survey of terrestrial and marine taxa exploited by human groups in this area between *ca*. 5500 and

370 years ago. A total of 244 species were recorded, of which 14 are currently endangered and 12 are no longer present in Babitonga Bay. This zooarchaeological synthesis provides snapshots of past biodiversity, adding a novel contribution to current debates around the conservation biology of one of the world's most threatened tropical biomes.

Keywords: Atlantic Forest, Babitonga Bay, archaeology, faunal record, conservation biology.

1. Introduction

1.1. Bridging conservation biology and archaeology in the Atlantic Forest coast of Brazil

The Atlantic Forest of Brazil is a hotspot of world biodiversity and one of the most threatened ecosystems on the planet, in which approximately 740 species of vertebrates and 8,000 species of vascular plants are endemic (Pinto et al., 2006; Colombo and Joly, 2010; Costa et al., 2017). This heterogeneous rainforest extends into tropical and subtropical regions, from the northeast coast of the state of Ceará to the coast of Rio Grande do Sul, and encompasses contrasting physiographic zones, rainfall regimes and phytogeographic units that contribute to an immense biodiversity and biological productivity, mainly in estuaries and mangrove ecosystems (Pinto et al., 2006; Cremer, 2006; Costa et al., 2017). More than 60% of the Brazilian population lives in or near the Atlantic Forest, which implies that social development, biological conservation and management of natural resources are intertwined subjects of continuous debate (Scarano and Ceotto, 2015). Historical exploitation of natural resources and population growth have caused considerable environmental impacts resulting in severe degradation, reduction, and even loss of important biomes (Mittermeier et al., 2004; Pinto et al., 2006) to the extent that only 7.3% of pre-European vegetation is estimated to currently remain (Morellato and Haddad, 2000; Costa et al., 2017). As a consequence, of the 2,059 species listed as currently endangered in Brazil, 49% are found in the Atlantic Forest (SISBio - portaldabiodiversidade.icmbio.gov.br/portal/). This has led to biological surveys and conservation ecology increasingly acting as the driving forces behind scientific research in the Atlantic Forest, setting the agenda of conservation policy in the region (Paglia et al., 2002; Pinto et al., 2006; Campanili and Schaffer, 2010; Norris et al., 2012; Galetti et al., 2017).

Regional and national checklists have been created as tools to identify areas of interest for conserving biodiversity (Key Biodiversity Areas) (Passos and Magalhães, 2011; Silva et al., 2016) and charismatic (or flagship) species of public interest (Silva et al., 2016), while others have proposed community-based, multilevel conservation and management efforts (Berkes, 2007). While these strategies are based on biological information covering only the last few decades, the Atlantic Forest has supported human populations for at least the last 8000 years (Lima et al., 2004). In fact, recent studies suggest that human impacts on Atlantic Forest biodiversity had begun long before European colonization and the subsequent urbanization of the region (Dean, 1997; Lopes et al., 2016).

In recent years, studies have demonstrated that archaeological and historical information provide valuable insights into conservation issues (Richards and Rago, 1999; Lyman, 2006; Wolverton and Lyman, 2012; Hofman et al., 2015; Lyman, 2015; Szabó, 2015; Engelhard et al., 2016) and offer the only currently available records of past biodiversity in some regions (Newbold, 2010; Alagona et al., 2012). Despite the fact that this approach is now gaining global recognition (Erlandson and Rick, 2008; Jackson and Jacquet, 2011; Braje et al., 2017), so far South America has received little attention (e.g. Castilho, 2008; Few and Tortorici, 2013). This also applies to the Atlantic Forest coast of Brazil, which preserves exceptional archaeological evidence of past human-environment interaction in the form of *sambaquis*, which literally means "mountain of shells” in the Tupi language. Despite the increasing number of archaeological studies in the Atlantic Forest, there has been little attempt to connect the zooarchaeological research with contemporary debates in conservation biology in this region (Souza et al., 2003; 2016; Lopes et al., 2016; Silva et al., 2017).

The sambaquis are cultural shell mounds and middens dating from *ca*. 8000 to 1000 years ago, which are composed of large quantities of animal remains (Gaspar, 1998; Wagner et al., 2011). Many of these sites contain numerous human burials, suggesting they were likely more than just middens, and expressed long standing political (territorial) and ideological values (DeBlasis et al., 1998; Gaspar 2008; Klokler, 2017). They represent the first tangible evidence of anthropogenic transformation of the Atlantic Forest coast (Villagran et al., 2011; Klokler, 2016). More than a thousand sites have been recorded along the Brazilian coast, but this is only a fraction of the original number as many have been totally destroyed in the last five hundred years through modern coastal development. These sites provide unique snapshots of past biodiversity (Lopes et al., 2016; Souza et al., 2016; Coe et al., 2017; Mendes et al., 2018) which can certainly contribute to the ongoing debates on modern anthropogenic disturbance to evolutionary ecological patterns, and ecosystem functioning and services in this region.

Here we review the literature on the zooarchaeology of sambaquis in order to provide a comprehensive taxonomic census encompassing several sites in Babitonga Bay, southern Brazil (Fig. 1A-B). We analysed the taxonomic compositions in the context of current national regulations for biodiversity protection and management, aiming to gather long-term information on biodiversity in the region while fostering the relevance of zooarchaeology to discussions on ecological baselines and related conservation issues in the Atlantic Forest.

1.2. Sambaquis of Babitonga Bay: unexplored and threatened biological archives

Among the 2000 sambaquis recorded along the Brazilian coast (Lopes et al., 2016), approximately 170 are located in Babitonga Bay, one of the regions with the highest concentration of these sites in Brazil (Okumura and Eggers, 2005; Bandeira, 2015). The sambaqui groups relied heavily on fishing, shellfish gathering, and hunting land mammals (Gaspar, 1998) as attested by the remarkable quantities of faunal remains in these sites. Several lines of evidence also indicate that plants played an important role in dietary and other aspects of daily life (Wesolowski and Neves, 2002; Peixe et al., 2007). Ceramic artefacts were introduced into this coastal area by groups moving from the southern Brazilian highlands around 1500 years ago (associated with Taquara/Itarare tradition; Bandeira 2015), yet faunal remains suggest that the human exploitation of local fish and terrestrial mammals continued relatively unchanged. The long-term interval of sambaqui occupation in Babitonga Bay is marked by important environmental changes, such as oscillations in relative sea level and in vegetation composition (Behling and Negrelle, 2001; Angulo et al., 2006), which may have affected subsistence strategies and the way faunal remains are represented in sambaquis.

Currently, the sambaquis of Babitonga Bay are under heavy economic and population pressure (Fig. 2A-C). The high biological productivity and strategic location of the estuary has bolstered distinct economic activities, from fisheries to industrial centers, including two ports and six other seaport projects (Prefeitura Municipal de Joinville, 2017; Gerhardinger et al., 2017; 2018). Population pressure has increased in the last decades, and currently the cities located around the bay comprise the highest population density of the state of Santa Catarina (Gerhardinger et al., 2017). While several conservation and archaeological efforts have been implemented locally in order to mitigate these impacts, many have either been ineffective or introduced too late to prevent the destruction of numerous archaeological sites. Moreover, an increase of 41% in deforestation of the Atlantic Forest in Santa Catarina state in only the last two years (SOS Mata Atlântica and INPE, 2017) directly expanded the list of threatened and endangered species. Today, a considerable number of sambaquis from Babitonga Bay have been destroyed, as the exploitation of shells for the lime industry was only banned in the mid-1960s (Fossile and Bandeira, 2013; Maciel and Bandeira, 2015).

2. Material and methods

2.1. The faunal record of sambaquis at Babitonga Bay

We accessed thirty-one sources of information dating from 1951 to 2018 reporting faunal remains from 110 sambaquis, representing approximately 65% of the sites recorded to date in this region (Fig. 1B; SI1). This comprehensive review included different types of analyses ranging from standardized archaeological surveys on well-defined excavated areas to random collections lacking detailed contextual information (SI2), and unravelled significant faunal variability.

Given the qualitative and quantitative variation observed in the bibliographic sources, we classified them as follows:

1. Qualitative-quantitative: sources with detailed taxonomic identification, and absolute and relative abundance of taxa (e.g. number of remains, number of individuals).

2. Semi-quantitative: sources reporting the number of identified species only.

3. Qualitative: sources that only report taxa identified *in-situ*, with apparently no support from reference collections.

Qualitative-quantitative and semi-quantitative sources (n = 22) usually provide faunal information at the species level derived from comparative analysis with reference collections and therefore provide more accurate taxonomic identifications.

These sources allowed us to generate a comprehensive list of taxa from 110 sambaquis, of which 44 were radiocarbon dated between 5,480 ± 30 (Sambaqui Praia Grande VI) and 375 ± 40 (Sambaqui Bupeva II) years before present (BP). Some of the youngest sites contained ceramic artefacts associated with the Taquara/Itarare tradition (Bandeira, 2015). Whenever possible, we provide the taxonomic information at the species level, but for some sites only genus, and often families, were available.

2.2. Species composition, distribution and status

The modern distribution of archaeological species in Babitonga Bay was assessed based upon recent regional checklists (Cherem *et al*., 2004; Cremer, 2006; Passos and Magalhães, 2011; Agudo-Padrón, 2014; Brazil, 2014a; 2014b; Gerhardinger et al., in press). Their conservation status was evaluated according to the categories and criteria of the IUCN Red List of Threatened Species and through the decrees 444/2014 (Brazil, 2014a) and 445/2014 (Brazil, 2014b) of Brazil's Ministry of the Environment (*Ministério do Meio Ambiente* - MMA). Both IUCN and MMA use the same categories and criteria for assessing endangered species, including population decline (past, present and/or predicted), restricted geographical distribution, fragmentation, decline or fluctuations, population size and quantitative analysis of extinction risk. However, some differences between IUCN and MMA categories arise due to the status and species evaluation in Brazilian territory.

3. Results and discussion

3.1. The current status of faunal remains from sambaqui sites

A total of 244 species were identified, belonging to seven major taxonomic groups: Annelida (1), Mollusca (Bivalvia, 67; Gastropoda, 59), Arthropoda (Crustacea: Malacostraca, 2; Hexanauplia, 2) and Chordata (Vertebrata: Elasmobranchii, 14; Actinopterygii, 57; Reptilia, 4; Ave, 3; and Mammalia, 35) (SI3). The results reveal a high diversity of taxa exploited by sambaqui populations, although species richness is likely underestimated, as, for instance, the most frequently reported taxa belong to marine molluscs, including *Anomalocardia flexuosa* (carib pointed venus) (95%), *Phacoides pectinatus* (thick lucine) (55%), *Crassostrea rhizophorae* (native oyster) (43%), *Ostrea* sp. (oyster) (39%), *Phrontis vibex* (bruised nassa) (53%), and *Neritina virginea* (virgin nerite) (33%). This is largely due to the nature of sambaqui deposits which are predominantly composed of sediments and shells, as well as the fact that mollusc shells tend to preserve better than mammal, fish and bird bone remains. Moreover, reference collections for purposes of comparison of terrestrial faunal remains, as well as local taxonomists of such organisms, are rare, and terrestrial specimens may also include cryptic species (Ceballos and Ehrlich, 2009) which make accurate identification difficult using only skeletal remains.

It is also worth noting that *Anomalocardia flexuosa*, *Phacoides pectinatus* and Ostreidae were possibly used as building materials in sambaquis (Gaspar, 1998), and as such they must have been abundantly distributed in Holocene coastal environments (Cancelli et al., 2017). Intertidal and subtidal molluscs are also easily exploitable as their acquisition does not pose a substantial risk when compared to some large mammals and fish. While *Anomalocardia flexuosa* and *Phacoides pectinatus* are not included in red lists, they are currently targeted as food sources by both humans (notably by artisanal fisheries) and other animals (Squella et al., 2015), so a decline in numbers has been reported due to overexploitation and dredging of coastal bays and estuaries along the Brazilian coast (Sônia-da-Silva et al., 2000; Squella et al., 2015). Worth noting is the occurrence of *Perna perna* (brown mussel) in two sambaquis (Bandeira, 1992, 2004), a species previously considered invasive in South America (Gernet and Birckolz, 2011; Souza et al., 2003, 2011), but recently confirmed to be native to this region (Pierri et al., 2016).

Several fish and terrestrial mammals frequently reported in sambaquis of this region are also currently abundant in the study area (Cherem et al., 2004; Gerhardinger et al., in press). These include *Trichiurus lepturus* (Atlantic cutlassfish), *Conodon nobilis*, (barred grunt), *Micropogonias furnieri* (whitemouth croaker), *Stellifer* spp. (drums or croakers), *Cynoscion leiarchus* (smooth weakfish), *Genidens barbus* (white sea catfish), *Lagocephalus laevigatus* (smooth puffer), *Cavia aperea* (Brazilian guinea pig) and *Dasyprocta* sp. (agouti) (Bandeira, 1992, 2004; Fossile, 2013). Two exotic species were identified, *Rattus norvegicus* (brown rat) and *Subulina octona* (miniature awlsnail), both possibly reflecting post depositional contamination due to European colonization and urban development.

According to Cherem *et al*., (2004), Passos and Magalhães (2011), Agudo-Padrón (2014) and Gerhardinger *et al*. (in press), 12 species reported in 14 sambaquis (13% of sites) have no current record in Babitonga Bay (SI3). These include one fish species, *Bagre bagre* (coco sea catfish), and 11 mollusc species, including *Atrina rigida* (stiff penshell), *Brachidontes darwinianus* (mussel), *Bulbus striatus* (sea snail), *Magallana ariakensis* (suminoe oyster), *Chione subrostrata* (cross-barred venus), *Colina macrostoma* (sea snail), *Conus regius* (crown cone), *Odontostomus paulistus* (land snail), *Phrontis antillarum* (Antilles nassa), *Phrontis polygonata* (sea snail), and *Vitrinella filifera* (threaded vitrinella). All the aforementioned molluscs are absent from the coast of Santa Catarina nowadays, while *B. striatus*, *C. macrostoma* and *M. ariakensis* are absent in all malacofauna databases from Brazil (Rios, 1994; World Register of Marine Species). According to Amaral and Simone (2014), the distribution of *M. ariakensis* in unclear and the species could actually refer to *Crassostrea rhizophorae*. The presence of these species in the sambaquis and their current absence in the regional checklist appears to support the ongoing process of defaunation in the Atlantic Forest (Dirzo et al., 2014; Galetti et al., 2017), with several species and/or populations known to be declining in abundance or disappearing entirely (Dirzo et al., 2014).

According to the IUCN Red List and/or the MMA decrees 444/2014 and 445/2014, at least 14 species recovered in eight sambaquis (7% of the sites) are currently threatened, within the categories of Vulnerable (VU), Endangered (EN), and Critically Endangered (CR) (SI3). These include *Panthera onca* (jaguar), *Puma concolor* (cougar), *Ozotoceros bezoarticus* (Pampas deer), *Tayassu pecari* (white-lipped peccary), *Tapirus terrestris* (lowland tapir), *Alouatta guariba* (brown howler), *Sotalia guianensis* (Guiana dolphin), *Genidens barbus*, *Pomatomus saltatrix* (bluefish), *Hyporthodus niveatus* (snowy grouper), *Isurus oxyrinchus* (shortfin mako shark), *Carcharodon carcharias* (great white shark), *Carcharias taurus* (sand tiger shark), and *Alopias vulpinus* (common thresher shark). In addition, teeth attributed to *Carcharhinus isodon* (finetooth shark) were found in sambaquis Itacoara and Bupeva II (Bandeira, 2004; SI3), and the species is classified as Regionally Extinct (RE) for the Brazilian coast (Brazil, 2016a; Brazil, 2016b). With the exception of *P. onca,* all of the aforementioned species were reported in publications where the authors were either specialists in the taxonomic analysis of faunal remains or had consulted such taxonomists, therefore their identifications are believed to be accurate.

Panthera onca was recorded only in the sambaqui of Rio Pinheiros II by Tiburtius *et al*. (1954), unfortunately without a secure stratigraphic context. *P. onca* is a flagship species considered Near Threatened (NT) (IUCN, 2017) and Vulnerable (VU) (Brazil, 2014a) that occurs in all Brazilian biomes, with the exception of the Pampa Biome, where it has gone extinct (Morato et al., 2013). Hunting, along with loss and fragmentation of habitat associated with agricultural expansion, mining, hydropower development, and road networks are its main threats (Morato et al., 2013). *Ozotoceros bezoarticus* entered the IUCN category of Near Threatened (NT) in 2002, while it gained the status of Vulnerable (VU) by MMA in 2014. In the last 15 years, populations of this species have declined due to habitat degradation, hunting, and disease. *P. onca* and *O. bezoarticus* are not currently found in this region (IUCN, 2017; Cherem et al, 2004).

Tapirus terrestris, Tayassu pecari, Alopias vulpinus, *Carcharias taurus, Carcharodon carcharias, Hyporthodus niveatus, Isurus oxyrinchus*, and *Pomatomus saltatrix* have all been classified as Vulnerable (VU) by the IUCN (2017). Based on MMA decrees 444/2015 (Brazil, 2014a) and 445/2014 (Brazil, 2014b), *C. taurus* is classified as Critically Endangered (CR) because its populations have been drastically reduced by commercial and artisanal fishing. *T. terrestris* and *T. pecari*, typically found in the Atlantic Forest, are classified as Endangered (EN) and CR, respectively, due to predatory hunting, habitat fragmentation, and increased urbanisation (Médici et al., 2012; Keuroghlian et al., 2012). *A. vulpinus* was never abundantly recorded on the Brazilian coast, whereas *C. carcharias* was considered abundant around the 16th century, but both it and *H. niveatu* have declined over the last few years due to overfishing (Brazil, 2016a).

Sotalia guianensis is currently under Vulnerable (VU) conservation status (Brazil, 2014). Present in Babitonga Bay, populations of *S. guianensis* are threatened by accidental catches, loss of habitat, acoustic pollution and water contamination (Cremer et al., 2009). Its occurrence in the sambaqui of Forte Marechal Luz, along with other cetaceans in 18 sites (16% of the record) around the bay, has been associated with the occasional exploitation and collection of stranded animals or carcasses. There is no evidence of systematic captures (Tiburtius, 1996; Castilho, 2008; Castilho and Simões-Lopes, 2001), suggesting that sambaqui groups from Babitonga Bay had minimal impact on local cetacean populations.

Alouatta guariba, Puma concolor, Genidens barbus, and *Carcharhinus isodon* are classified as Least Concern (LC) by the IUCN. However, according to MMA decrees 444/2014 (Brazil 2014a) and 445/2014 (Brazil 2014b), the first two species are now Critically Endangered (CR) and Vulnerable (VU), respectively, due to habitat fragmentation, roadkill incidents, and hunting (Neves et al., 2015; Azevedo et al., 2013). *G. barbus* is a long-lived species with a low reproduction rate, highly sensitive to human impact, and classified as Endangered (EN). *C. isodon* has a vulnerable life cycle and entered the category of

Regionally Extinct (RE) (Brazil, 2016a). *Galeocerdo cuvier* (tiger shark), *Prionace glauca* (blue shark), *Thalassarche melanophris* (black-browed albatross) and *Spheniscus magellanicus* (Magellanic penguin) are currently affected by overexploitation and habitat degradation, and classified as Near Threatened (NT) by the IUCN (2017) and MMA (2014). All of these species are currently recorded in Babitonga Bay (IUCN, 2017; Gerhardinger et al., in press).

3.2. Integrating archaeology into conservation biology in the Atlantic Forest

Due to mutualistic interactions between forest components (e.g. fauna, vegetation, cycle of nutrients) the consequences of biodiversity loss and population decline on ecosystem function are complex and nonlinear (Dirzo et al., 2014; Pires et al., 2014). Human disturbances are major factors in this process, and have transformed tropical ecosystems long before historical times (Roberts et al., 2017), thus a temporal perspective beyond historical records is highly desirable (Lyman, 2015). Archaeology can provide valuable contributions to conservation debates in the Atlantic Forest by offering just such a perspective. The review of the literature presented above was not aimed at elucidating a diachronic narrative of human-environment interaction in Babitonga Bay through time, but rather at highlighting the potential of archaeology to critically assess the conservation status of a number of species with the longstanding temporal dimensions that are increasingly required for conservation efforts. The results reveal that pre-Columbian coastal populations in this region interacted with a wide range of terrestrial and marine organisms between *ca.* 5500 and 370 years ago, some of which are currently either in decline or no longer reported in this area of the Atlantic Forest.

Babitonga Bay has been considered a strategic region for the creation of the first Wildlife Reserve in Brazil (Brazil, 2007) and more recently of a Marine Protected Area (Brazil, 2012; Gerhardinger et al., 2017), yet modern faunal information is limited for the region (Vilar et al., 2011). Several of the marine species that are presently exploited by small-scale and industrial fisheries are relatively abundant in the sambaquis of Babitonga Bay (Fig. 2D). Their remains can be systematically recovered from well-dated archaeological deposits and analyzed in order to explore the impact of centennial to millennial scale changes in cultural practices, changes in climate and environmental conditions on species diversity, distribution, size and abundance, and on trophic interactions and population dynamics. This information can potentially complement and integrate historical baselines spanning the last few decades (Gerhardinger et al., 2006; Vilar et al., 2011; Bender et al., 2014; Pinheiro et al., 2015) to guide decision making processes in conservation efforts.

However, it is important to point out that we detected problems with the available archaeological record, notably the lack of robust taxonomic and taphonomic analyses of faunal remains, which introduce some limitations to its crude applicability to conservation actions. These limitations can be mitigated by establishing common protocols for sampling and data analysis that also address taphonomic processes in tropical areas, as well as by expanding the methodology and the research portfolio to integrate biomolecular techniques, such as archaeogenomics, proteomics, and stable isotope analysis of faunal remains (McKechnie et al., 2014; Hofman et al., 2015; McKechnie and Moss, 2016; West et al., 2017).

Archaeology is a valuable source of information for tracking long-term changes in forest ecosystems and biological diversity in the Neotropics (Stahl, 1996). The time has come for the discipline to realize this potential (van der Leeuw and Redman, 2002), and for us to explore a niche in conservation biology and management initiatives in the Atlantic Forest. This process requires the development of transdisciplinary research collaborations between archaeologists, conservation biologists and stakeholders, where operational principles, research questions, aims, methods and desirable outcomes are jointly decided and monitored through cooperation (Meyer et al., 2011). The training of graduate and postgraduate students in South American archaeology should also reflect upon the relevance of the discipline to the current environment and conservation agenda.

4. Conclusion

Our review of the literature on the zooarchaeology of sambaquis resulted in a comprehensive census of terrestrial and marine taxa exploited by human groups in Babitonga Bay, southern Brazil, between *ca.* 5500 and 300 years ago. The increased demand for a multidisciplinary and temporal perspective in conservation debates offers the opportunity for the archaeology of the Neotropics to interact with and actively contribute to conservation actions, thereby enhancing the relevance of the discipline to environmental issues at local, regional and national levels. This could in turn enhance the ecological visibility of the archaeological sites, offering additional leverage for preservation and transdisciplinary significance. After all, sites such as the sambaquis of Babitonga Bay offer unique and often otherwise inaccessible glimpses of past biodiversity in some of the most diverse and threatened tropical biomes on the planet.

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Figure caption

Figure 1. (A) Study area in South America and (B) the location of sambaqui sites discussed in the text (see also SI1)

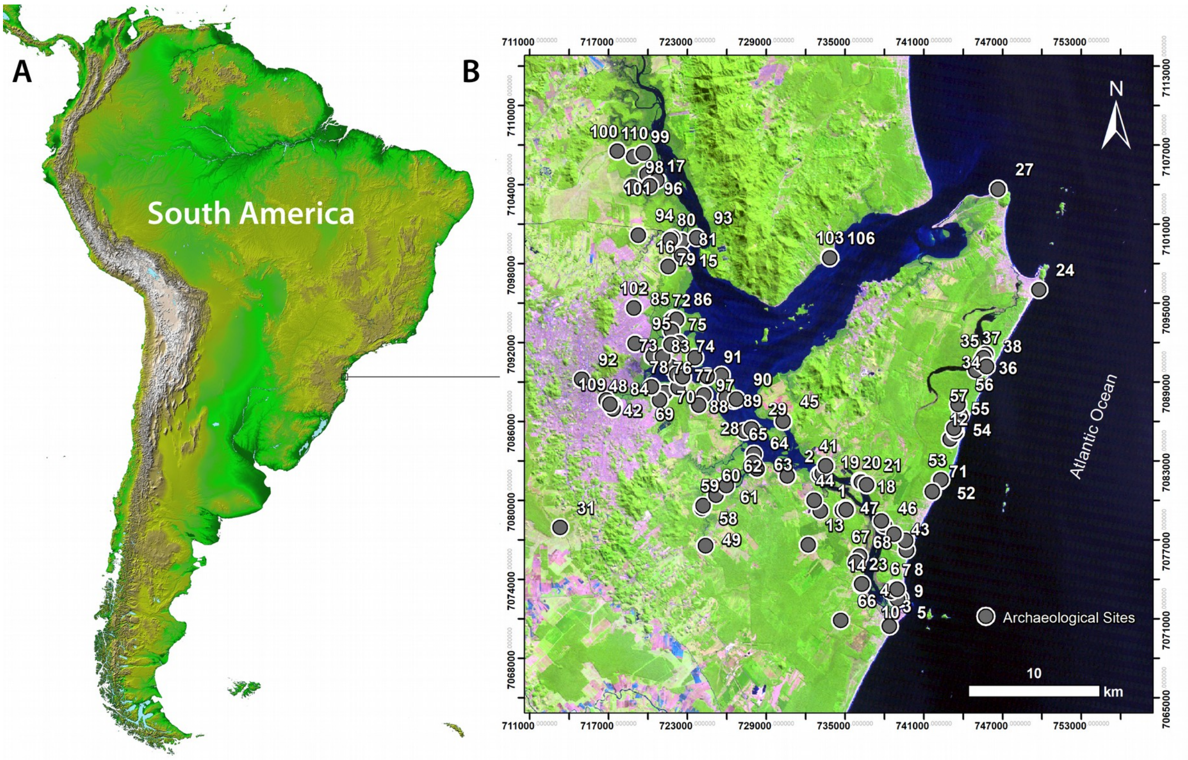

Figure 2. (A) The sambaqui of Rio Comprido, excavated in the 1970s, has partially survived the urban development in Joinville; (B) the sambaqui of Morro do Ouro has been partially excavated in the last decades and it is now a municipal park; (C) sites such as the sambaqui of Cubatão I, excavated between 2007 and 2009, are threatened by fluvial activity and changes in land use practices; (D) an example of fish bone from Cubatão I (*Epinephelus* spp.). Shell and fish bones are the most abundant biological remains resulting from thousands of years of food refuse and funerary feasts. Pictures A and B were kindly provided by the *Museu Arqueológico de Sambaqui de Joinville*.

Supplementary Information

SI1. Sambaquis of Babitonga Bay discussed in the text with their respective cultural attribution, geographic coordinates and absolute chronology.

SI2. Bibliographic sources and categories of the sambaqui sites in Babitonga Bay.

SI3. Checklist of identified taxa in sambaqui sites of Babitonga Bay. M, marine; B, brackish; F, freshwater; FO, frequency of species; *, exotic species. Conservation status according to

IUCN Red List and decrees 444/2014 and 445/2014 of Brazil's Ministry of the Environment (*Ministério do Meio Ambiente* – MMA).

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4 DISCUSSÃO

A capacidade de conhecer, memorizar e desenvolver tecnologias para sua subsistência possibilitou à sociedade humana expandir suas habilidades e desenvolver formas de adaptação e domínio sobre o ambiente, causando mudanças significativas no ecossistema (LIMA, 2000; LOPES et al. 2016). Essas alterações causadas pelas sociedades passadas ficaram registradas no tempo e no espaço, sendo expressas das mais variadas formas, como os registros zooarqueológicos encontrados em sítios arqueológicos, conhecidos por sambaquis.

Ao analisarmos as informações e os dados arqueológicos disponíveis para o Holoceno médio e tardio na Baía Babitonga, bem como a partir da análise da arqueofauna do sambaqui Cubatão I, criamos um modelo cronológico da ocupação pré-colonial, e desenvolvemos a reconstrução de captura de pescados para um período de aproximadamente 6000 anos de ocupação na região, aportando novos conhecimentos no que diz respeito a composição e a abundância relativa dos peixes ósseos e cartilaginosos na pré-história brasileira. Este estudo teve como objetivo integrar a arqueologia aos atuais debates, e a participar de diálogos com as áreas ambientais e políticas sobre conservação e estratégias de manejo em pescarias de pequena escala e de subsistência. Os resultados aqui obtidos demonstram uma taxa de captura de 12.9 t/ano^{-1}, um pouco abaixo das capturas de subsistência estimada para o estado de Santa Catarina na década de 1950, no entanto, vale destacar que o número de pescarias oficialmente registradas na Baía Babitonga corresponde a cerca de 9,2% do total para o litoral do estado de Santa Catarina.

Além disso, a revisão da literatura sobre arqueofauna em sambaquis na Baía Babitonga resultou em um amplo censo de *taxa* terrestres e marinhos explorados por grupos humanos que viveram na Baía Babitonga, no sul do Brasil, entre 6000 e 300 anos AP. Embora a Baía Babitonga desde meados do século XX venha sendo alvo de inúmeras intervenções arqueológicas, as publicações técnicas bem desenvolvidas resumem-se a 12 estudos, totalizando 110 sítios com caracterização e composição dos remanescentes faunísticos no âmbito quali-quantitativo. Ao analisarmos os dados publicados previamente, registramos 244 espécies, sendo que 14 dessas estão atualmente em categorias de ameaça (Vulnerável, Em perigo e Criticamente em perigo), e uma espécie regionalmente extinta, de acordo com as listas de espécies ameaçadas de extinção no âmbito nacional (BRASIL, 2014a; 2014b) e internacional (http://www.iucnredlist.org).

Esse tipo de abordagem vem ganhando reconhecimento mundial, porém a América Latina recebeu pouca atenção até o momento (COSTELLO et al. 2010, ENGELHARD et al. 2016, BURGER 2016). Os estudos arqueológicos desenvolvidos na costa brasileira, em sua maioria, carecem de informações imprescindíveis para a realização de reconstruções como a que desenvolvemos neste trabalho. Sentiu-se dificuldade em obter as mensurações (comprimento, largura, comprimento e volume) dos sítios arqueológicos, a densidade de indivíduos, ou os valores para calcular o número mínimo de indivíduos por m^3, muitas vezes prejudicados pela lacuna de estudos e coleções de referência para identificação de peças ósseas de peixes na região neotropical. Sabemos, no entanto, que uma coleção de referência bem elaborada é de fundamental importância para os estudos da arqueofauna, mas também é compreensível a dificuldade financeira e espacial das instituições nacionais para a elaboração, armazenamento, e curadoria das coleções.

Portanto, para que a arqueologia e a história, como disciplinas de conhecimento passado, possam participar dos debates atuais sobre a sustentabilidade e a biodiversidade, necessita-se de maiores incentivos, por parte das instituições de ensino, pesquisa e extensão, e das instituições governamentais e políticas, para a formação contínua e a participação de estudantes na produção de pesquisas com metodologias bem definidas com este viés ambiental, bem como para a elaboração de materiais e coleções de referências mais apuradas para auxiliar a identificação taxonômica e, portanto, refinar os resultados arqueológicos.

5 CONCLUSÃO

O presente estudo enfatiza a contribuição que o registro arqueológico pode fornecer para debates cruciais em biologia e manejo de conservação na região costeira da Mata Atlântica. O aumento da demanda por uma perspectiva multidisciplinar e temporal nos debates sobre conservação oferece a oportunidade para a arqueologia neotropical interagir, e contribuir com ações orientadas para políticas públicas, aumentando assim a relevância da disciplina para as questões ambientais nas diferentes esferas federativas e mundial. Os resultados aqui obtidos condizem com os estudos da arqueofauna (BANDEIRA, 1992, 2004) e análises de isótopos estáveis de colágeno ósseo (BASTOS et al. 2014; PEZO-LANFRANCO et al. 2018), os quais revelam que o peixe era a fonte predominante de proteína na dieta e, na maioria dos casos, também calorias na Baía Babitonga.

As pesquisas com essas finalidades não se esgotam, pelo contrário, o presente estudo é apenas um pontapé inicial para uma mudança na agenda arqueológica da Baía Babitonga, e da região costeira da Mata Atlântica, tendo em vista que os trabalhos arqueológicos anteriormente realizados na região, em sua maioria, carecem de informações para a realização de reconstruções como a que desenvolvemos. Além disso, há necessidade de realização de um foco maior, por parte dos pesquisadores, em elaborar guias de identificação de espécimes de peixes, principalmente, pré-cranianas, na região neotropical. Esse aprofundamento auxiliará o arqueozoólogo na identificação de espécimes da arqueofauna, portanto, refinará a qualidade dos dados da biodiversidade do passado, uma vez que a ausência de coleções e publicações de referência bem elaboradas, desde o seu início, dificulta o detalhamento taxonômico dos espécimes arqueológicos.

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APÊNDICE

Apêndice A – Artigo 1: Supplementary Information 1 – Conventional 14C dates Cubatão I

Sector	Sample	Conventional 14C yr BP	Laboratory Code	Material	Reference
Upper	Grid N05E01	2560 ± 40	Beta-259823	Shell	Figuti (2009)
Upper	Burial 1a	2430 ± 40	Beta-268518	Human bone	Figuti (2009)
Upper	Grid N09W12	2250 ± 40	Beta-268526	Charcoal	Figuti (2009)
Upper	Burial 11	2460 ± 40	Beta-268523	Human bone	Figuti (2009)
Upper	Burial 14	2460 ± 40	Beta-268525	Human bone	Figuti (2009)
Upper	Burial 1b	2460 ± 30	Ly- 4524	Human bone	Figuti (2009)
Upper	Burial 6	2495 ± 30	Ly-4527	Human bone	Figuti (2009)
Upper	Burial 12	2510 ± 40	Beta 268524	Human bone	Figuti (2009)
Upper	Burial 4	2520 ± 40	Beta-259519	Human bone	Figuti (2009)
Upper	Burial 7	2520 ± 40	Ly-4528	Human bone	Figuti (2009)
Upper	Grid N17E02	2660 ± 40	Beta-259824	Shell	Figuti (2009)
Upper	Burial 5	2620 ± 30	Ly-4526	Human bone	Figuti (2009)
Upper	Burial 9	2630 ± 40	Beta-259821	Human bone	Figuti (2009)
Upper	Burial 8	2670 ± 40	Beta-259820	Human bone	Figuti (2009)
Lower	Survey S49E08	2890 ± 70	Beta-259827	Charcoal	Figuti (2009)
Lower	Grid N20W33	2970 ± 60	Beta-259825	Charcoal	Figuti (2009)
Lower	Center base	2975 ± 30	Ly-4525	Charcoal	Figuti (2009)
Lower	Survey S55E20 F	3040 ± 60	Beta-259829	Charcoal	Figuti (2009)
Lower	Center base 1	3110 ± 70	Beta-259826	Charcoal	Figuti (2009)
Lower	Survey S55E20 C	3480 ± 60	Beta-259828	Shell	Figuti (2009)

Apêndice B – Artigo 1: Supplementary Information 1 – Conventional 14C dates Babitonga's shell-mound and middens

Site	Material	aceramic/ceramic	Lab code	Conventional 14C date BP	Calibration curve	Modelled carbon source	(ΔR)	Reference
Areias Pequenas	Bone	aceramic (sambaquis)	Beta 443867	780 ± 30	SHCal13	100% atmospheric	0	Bandeira and Almeida (2016)
Bupeva I	shell	aceramic (sambaquis)	Beta 397493	1390 ± 30	Marine13	100% marine	23 ± 52	
Bupeva I	shell	aceramic (sambaquis)	Beta 397494	1440 ± 30	Marine13	100% marine	23 ± 52	
Bupeva II	Bone	aceramic (sambaquis)	KIA 22262	2325 ± 25	Marine13	100% marine	23 ± 52	Bandeira (2004); Bandeira (2018)
Bupeva VII	shell	aceramic (sambaquis)	Beta 397496	2710 ± 30	Marine13	100% marine	23 ± 52	
Bupeva VII	shell	aceramic (sambaquis)	Beta 397495	2720 ± 30	Marine13	100% marine	23 ± 52	
Bupeva VIII	shell	aceramic (sambaquis)	Beta 452919	3450 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Bupeva VIII	shell	aceramic (sambaquis)	Beta 452916	3570 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Casa de Pedra	human bone	aceramic (sambaquis)	Beta 418378	4460 ± 30	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Bandeira (2018)
Casa de Pedra	shell	aceramic (sambaquis)	Beta 418377	5470 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Costeira	Bone	aceramic (sambaquis)	Beta 443868	3860 ± 30	SHCal13	100% atmospheric	0	Bandeira and Almeida (2016)
Cubatão I	Charcoal	aceramic (sambaquis)	Beta 268526	2250 ± 40	SHCal13	100% atmospheric	0	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 268518	2430 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Ly 4524	2460 ± 30	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 268525	2460 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 268523	2460 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Ly 4527	2495 ± 30	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 268524	2510 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 259519	2520 ± 30	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Ly 4528	2520 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	Shell	aceramic (sambaquis)	Beta 259823	2560 ± 40	Marine13	100% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Ly 4526	2620 ± 30	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 259821	2630 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	Shell	aceramic (sambaquis)	Beta 259824	2660 ± 40	Marine13	100% marine	23 ± 52	Figuti (2009)
Cubatão I	human bone	aceramic (sambaquis)	Beta 259820	2670 ± 40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Cubatão I	Charcoal	aceramic (sambaquis)	Beta 259827	2890 ± 70	SHCal13	100% atmospheric	0	Figuti (2009)
Cubatão I	Charcoal	aceramic (sambaquis)	Beta 259825	2970 ± 60	SHCal13	100% atmospheric	0	Figuti (2009)
Cubatão I	Charcoal	aceramic (sambaquis)	Ly 4525	2975 ± 30	SHCal13	100% atmospheric	0	Figuti (2009)
Cubatão I	Charcoal	aceramic (sambaquis)	Beta 259829	3040 ± 60	SHCal13	100% atmospheric	0	Figuti (2009)
Cubatão I	Charcoal	aceramic (sambaquis)	Beta 259826	3110 ± 70	SHCal13	100% atmospheric	0	Figuti (2009)
Cubatão I	Shell	aceramic (sambaquis)	Beta 259828	3480 ± 60	Marine13	100% marine	23 ± 52	Figuti (2009)
Cubatão III	shell	aceramic (sambaquis)	CEN 1133	3570 ± 70	Marine13	100% marine	23 ± 52	Figuti (2009); Bandeira et al. (2010)
Cubatão III	shell	aceramic (sambaquis)	CEN 1132	3680 ± 70	Marine13	100% marine	23 ± 52	Figuti (2009); Bandeira et al. (2010)
Cubatão III	shell	aceramic (sambaquis)	no ID	3930 ± 40	Marine13	100% marine	23 ± 52	Figuti (2009); Bandeira et al. (2010)
Cubatão III	shell	aceramic (sambaquis)	no ID	3930 ± 60	Marine13	100% marine	23 ± 52	Figuti (2009); Bandeira et al. (2010)
Cubatão IV	shell	aceramic (sambaquis)	CEN 1128	2750 ± 70	Marine13	100% marine	23 ± 52	Bandeira et al (2010)
Cubatão IV	shell	aceramic (sambaquis)	CEN 1129	2910 ± 70	Marine13	100% marine	23 ± 52	Bandeira et al (2010)
Cubatãozinho	shell	aceramic (sambaquis)	CEN 1127	4760 ± 80	Marine13	100% marine	23 ± 52	Bandeira et al. 2010

Enseada I	Bone	aceramic (sambaquis)	no ID	3920 ± 40	SHCal13	100% atmospheric	0	De Masi (2009)
Espinheiros II	charcoal	aceramic (sambaquis)	Gif 9415	1160 ± 45	SHCal13	100% atmospheric	0	Afonso e De Blasis (1994); Oliveira (2000)
Espinheiros II	charcoal	aceramic (sambaquis)	no ID	1270 ± 60	SHCal13	100% atmospheric	0	Afonso e De Blasis (1994); Oliveira (2000)
Espinheiros II	charcoal	aceramic (sambaquis)	Gif 9416	2970 ± 60	SHCal13	100% atmospheric	0	Afonso e De Blasis (1994); Oliveira (2000)
Forte Marechal Luz	Charcoal	aceramic (sambaquis)	M 1208	3660 ± 130	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Forte Marechal Luz	Marine mammal bone	aceramic (sambaquis)	Birm 704	4290 ± 130	Marine13	100% marine	23 ± 52	Bryan (1993; 1997)
Forte Marechal Luz	Charcoal	ceramic	M 1024	1100 ± 100	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Forte Marechal Luz	Charcoal	ceramic	M 1206	1440 ± 110	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Forte Marechal Luz	Charcoal	ceramic	M 1207	2060 ± 120	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Forte Marechal Luz	Charcoal	ceramic	M 1203	620 ± 10	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Forte Marechal Luz	Charcoal	ceramic	M 1200	640 ± 100	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Forte Marechal Luz	Charcoal	ceramic	M 1205	850 ± 100	SHCal13	atmospheric	0	1997)
Forte Marechal Luz	Charcoal	ceramic	M 1202	880 ± 100	SHCal13	100% atmospheric	0	Bryan (1993; 1997)
Guanabara I	Charcoal	aceramic (sambaquis)	Beta 443869	2810 ± 30	SHCal13	100% atmospheric	0	Bandeira and Almeida (2016)
Guanabara II	charcoal	aceramic (sambaquis)	Beta 96756	2350 ± 120	SHCal13	100% atmospheric	0	Oliveira (2000)
Ilha dos Espinheiros II	charcoal	aceramic (sambaquis)	Gif 6166	1170 ± 200	SHCal13	100% atmospheric	0	Oliveira (2000)
Ilha dos Espinheiros II	charcoal	aceramic (sambaquis)	Gif 6167	2730 ± 80	SHCal13	100% atmospheric	0	Oliveira (2000)
Ilha dos Espinheiros II	charcoal	aceramic (sambaquis)	St 8413	3000 ± 95	SHCal13	100% atmospheric	0	Oliveira (2000)
Ilha dos Espinheiros II	charcoal	aceramic (sambaquis)	St 8414	3015 ± 130	SHCal13	100% atmospheric	0	Oliveira (2000)
Itacoara	Charcoal	ceramic	KIA 21796	1570 ± 20	SHCal13	100% atmospheric	0	Bandeira (2004)
Lagoa do Acarai I	shell	aceramic (sambaquis)	Beta 446685	2350 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai I	shell	aceramic (sambaquis)	no ID	3600 ± 180	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai III (S12)	shell	aceramic (sambaquis)	Beta 446686	4240 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai IV (S10)	shell	aceramic (sambaquis)	Beta 452918	3390 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai IV (S10)	shell	aceramic (sambaquis)	Beta 418383	3450 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai IV (S10)	shell	aceramic (sambaquis)	Beta 418382	3500 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai V (S11)	shell	aceramic (sambaquis)	Beta 446989	3540 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Acarai VII (S13)	shell	aceramic (sambaquis)	Beta 446688	3290 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Lagoa do Saguacú	tooth	aceramic (sambaquis)	Beta 443870	4630 ± 30	SHCal13	100% atmospheric	0	Martin et al. (1988)
Morro do Ouro	human bone	aceramic (sambaquis)	AA104770	3938±55	Marine13-SHCal13	3.7±2.7 marine	23 ± 52	Pezo-Lanfranco et al., 2018
Morro do Ouro	human bone	aceramic (sambaquis)	no ID	4030±40	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Oliveira, 2000
Morro do Ouro	human bone	aceramic (sambaquis)	AA104768	4086±42	Marine13-SHCal13	60.9±5.8 marine	23 ± 52	Pezo-Lanfranco et al., 2018
Morro do Ouro	human bone	aceramic (sambaquis)	Beta 444034	4200±30	Marine13-SHCal13	63.7±5.6 marine	23 ± 52	Pezo-Lanfranco et al., 2018
Morro do Ouro	human tooth	aceramic (sambaquis)	AA104767	4425 ± 39	Marine13-SHCal13	73.2±3.6 marine	23 ± 52	Pezo-Lanfranco et al., 2018
Perequê da Praia Grande	shell	aceramic (sambaquis)	Beta 446687	2940 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Pernambuco	Bone	aceramic (sambaquis)	Beta 443871	5030 ± 30	SHCal13	100% atmospheric	0	Bandeira and Almeida (2016)
Ponta das Palmas	Shell	aceramic (sambaquis)	CEN 1134	2430 ± 70	Marine13	100% marine	23 ± 52	Figuti (2009); Bandeira et al. (2010)
Ponta das Palmas	Charcoal	ceramic	CEN 1135	600 ± 80	SHCal13	100% atmospheric	0	Figuti (2009); Bandeira et al. (2010)
Praia do Ervino I	shell	aceramic (sambaquis)	Beta 446691	3080 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande I	shell	aceramic (sambaquis)	Beta 452914	3640 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande I	shell	aceramic (sambaquis)	Beta 452920	3650 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande II	shell	aceramic (sambaquis)	no ID	3850 ± 200	Marine13	100% marine	23 ± 52	Bandeira (2018); Martin et al. (1988)
Praia Grande II	shell	aceramic (sambaquis)	Beta 452915	4700 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018); Martin et al. (1988)

Praia Grande III	shell	aceramic (sambaquis)	Beta 452912	3870 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande IV	shell	aceramic (sambaquis)	Beta 453208	3920 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande IV	shell	aceramic (sambaquis)	Beta 446684	3980 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande IX	shell	aceramic (sambaquis)	Beta 446690	5470 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande V	shell	aceramic (sambaquis)	Beta 418381	4670 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande VI	human bone	aceramic (sambaquis)	Beta 418379	4690 ± 30	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Bandeira (2018)
Praia Grande VI	shell	aceramic (sambaquis)	Beta 418380	5270 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande VI	shell	aceramic (sambaquis)	Beta 452917	5480 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande VII	shell	aceramic (sambaquis)	Beta 452911	3330 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande VII	shell	aceramic (sambaquis)	Beta 452913	3350 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande VIII	shell	aceramic (sambaquis)	Beta 446683	3090 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Praia Grande XI (S2)	shell	aceramic (sambaquis)	Beta 452910	5950 ± 30	Marine13	100% marine	23 ± 52	Bandeira (2018)
Ribeirão do Cubatão	shell	aceramic (sambaquis)	CEN 1130	4010 ± 70	Marine13	100% marine	23 ± 52	Bandeira et al. (2010)
Ribeirão do Cubatão	shell	aceramic (sambaquis)	CEN 1131	5040 ± 80	Marine13	100% marine	23 ± 52	Bandeira et al. (2010)
Rio Bucuriuma	Shell	aceramic (sambaquis)	no ID	1190 ± 40	Marine13	100% marine	23 ± 52	Figuti (2009)
Rio Bucuriuma	human bone	aceramic (sambaquis)	no ID	1340 ± 50	Marine13-SHCal13	56.8±0.8% marine	23 ± 52	Figuti (2009)
Rio Comprido	human bone	aceramic (sambaquis)	Beta444032	1140±30	Marine13-SHCal13	59.5±6.0 % marine	23 ± 52	Pezo-Lanfranco et al., 2018
Rio Comprido	human bone	aceramic (sambaquis)	Beta448932	3510±30	Marine13-SHCal13	65.0±5.3% marine	23 ± 52	Pezo-Lanfranco et al., 2018
Rio Comprido	human bone	aceramic (sambaquis)	Beta448933	3820±30	Marine13-SHCal13	66.7±5.1% marine	23 ± 52	Pezo-Lanfranco et al., 2018
Rio Comprido	human tooth	aceramic (sambaquis)	AA104771	4320±61	Marine13-SHCal13	72.1±3.9 marine	23 ± 52	Pezo-Lanfranco et al., 2018
Rio Comprido	human bone	aceramic (sambaquis)	Beta 444033	5090±30	Marine13-SHCal13	70.4±4.4 marine	23 ± 52	Pezo-Lanfranco et al., 2018
Rio Pinheiros II	Bone	aceramic (sambaquis)	no ID	3850 ± 140	SHCal13	100% atmospheric	0	Prous e Piazza (1977) in Figuti (2009); Bandeira and Almeida (2016)
Rio Pinheiros II	Bone	aceramic (sambaquis)	no ID	4580 ± 120	SHCal13	100% atmospheric	0	Prous e Piazza (1977) in Figuti (2009); Bandeira and Almeida (2016)
Rio Pinheiros II	Bone	ceramic	Beta 443872	860 ± 30	SHCal13	100% atmospheric	0	Prous e Piazza (1977) in Figuti (2009); Bandeira and Almeida (2016)
Rua Guaira	shell	aceramic (sambaquis)	CEN 458	5200 ± 70	Marine13	100% marine	23 ± 52	provided by Dione da Rocha Bandeira

Apêndice C – Artigo 1: Supplementary Information 1 – Archaeological otolith metrics

ID_Cubatao	Laterality	MAX_OL_mm	MAX_OH_mm	Estimated total length (mm) using Eq. 1	Estimated wet-weight (g) using Eq. 2
Area A					
MIFU.N14W1.2786.1	right	10,38	8,18	258,6166	124,80
MIFU.N14W1.2803.1	right	15,72	13,46	379,1404	441,16
MIFU.N14W1.817.1	right	13,78	10,48	335,3546	295,51
MIFU.N15W1.1111.1	right	12,62	8,58	309,1734	226,15
MIFU.N15W1.2864.1	left	18,9	15,33	450,913	772,69
MIFU.N16W1.2048.1	right	19,85	16,45	472,3545	897,01
MIFU.N16W1.2857.1	left	15,88	13,2	382,7516	454,97
MIFU.N16W1.3209.1	right	8,78	6,96	222,5046	75,00
MIFU.N16W1.3832.1	left	11,08	8,95	274,4156	152,21
MIFU.N16W1.3832.2	right	6,17	5,07	163,5969	25,64
MIFU.N16W1.3832.3	right	6,17	5,09	163,5969	25,64
Area B					
MIFU.N4W1/N5W2.3024.1	left	16,87	13,09	405,0959	546,87
MIFU.N4W1/N5W2.3190.1	left	8,67	6,92	220,0219	72,18
MIFU.N4W1/W2-N5W2.3190.1	right	18,16	14,46	434,2112	684,28
MIFU.N4W1/W2-N5W2.3190.7	right	9,37	7,39	235,8209	91,41
MIFU.N5W1.152.1	left	17,05	13,36	409,1585	564,81
MIFU.N5W1.2370.1	right	17,97	14,87	429,9229	662,73
MIFU.N5W1.2397.1	left	10,61	8,44	263,8077	133,41
MIFU.N5W1.2761.1	right	17,6	14,64	421,572	622,09
MIFU.N5W1.2761.4	left	10,82	7,9	268,5474	141,60
MIFU.N5W1.3286.1	right	7,8	6,43	200,386	52,32
MIFU.N5W1.3738.1	left	6,33	5,17	167,2081	27,72
MIFU.N5W2.2986.1	right	14,64	12,05	354,7648	355,27
MIFU.N5W2.2986.2	left	8,95	7,22	226,3415	79,50
MIFU.N5W2.3390.1	left	7,78	5,47	199,9346	51,91
MIFU.N6W1.2857.2	left	20,74	16,37	492,4418	1025,05
MIFU.N6W1.3835.1	left	10,14	7,74	253,1998	116,23
Area C					
MIFU.N8W13.2347.2	right	8,97	6,99	226,7929	80,05
MIFU.N8W13.2454.1	left	16,32	13,66	392,6824	494,41
MIFU.N8W13.2454.2	left	9,56	7,9	240,1092	97,16
MIFU.N8W13.2486.1	right	16,67	13,21	400,5819	527,38
MIFU.N8W13.2671.1	right	14,7	11,7	356,119	359,72
MIFU.N8W13.3455.1	left	7,31	5,75	189,3267	42,95
MIFU.N8W13.3476.1	left	17,95	14,11	429,4715	660,49
MIFU.N8W13.3476.2	right	18,68	15,66	445,9476	745,65
MIFU.N8W13.3476.3	right	16,97	14,3	407,3529	556,79
MIFU.N8W13.3476.4	right	9,58	7,66	240,5606	97,78
average weight					334,61
std					284,42

Apêndice D – Artigo 1: Supplementary Information 1 – Volume of sites

Site	width (m)	length (m)	height (m)	radius (m)	Estimated volume (m3) using Eq. 3	Reference
Sambaqui Rio Pirabeiraba (Sambaqui do Birú)	70	80	10	40	25656	Oliverira (2000)
Sambaqui Rio Bucuriuma	70	80	3	40	7554	Oliverira (2000)
Sambaqui Rio Ferreira	80	70	9	35	17699	Oliverira (2000)
Sambaqui Rio das Ostras	50	70	18	35	37689	Oliverira (2000)
Sambaqui Rio Sambaqui	40	60	1,5	30	2122	Oliverira (2000)
Sambaqui Tiburtius	135	145	18	72,5	151666	Oliverira (2000)
Sambaqui Rio Fagundes	25	45	1,5	22,5	1195	Oliverira (2000)
Sambaqui Ribeirão do Cubatão	72	70	18	35	37689	Oliverira (2000)
Sambaqui Ponta das Palmas	14	20	2,5	10	401	Oliverira (2000)
Sambaqui Cubatão II	60	70	1,5	35	2888	Oliverira (2000)
Sambaqui Cubatão I	130	90	9	45	29009	Oliverira (2000)
Sambaqui Cubatão III	130	110	9,5	55	45588	Oliverira (2000)
Sambaqui Cubatão IV	80	60	6	30	8595	Oliverira (2000)
Sambaqui Cubatãozinho (Sambaqui do Aeroporto)	100	140	1	70	7697	Oliverira (2000)
Sambaqui Rua Guaíra	40	40	16	20	12197	Oliverira (2000)
Sambaqui Ilha do Gado I	30	40	4	20	2547	Oliverira (2000)
Sambaqui Ilha do Gado III	85	50	1,5	25	1474	Oliverira (2000)
Sambaqui Ilha do Gado II	70	70	4	35	7730	Oliverira (2000)
Sambaqui Ilha do Gado IV	55	60	1	30	1414	Oliverira (2000)
Sambaqui Ilha dos Espinheiros III	110	30	2	15	711	Oliverira (2000)
Sambaqui Rio Comprido (Sambaqui do Comasa)	60	110	9	55	43145	Oliverira (2000)
Sambaqui Ilha dos Espinheiros IV (Sambaqui Moinho dos Ventos	46	40	6,5	20	4228	Oliverira (2000)
Sambaqui Espinheiros II (Sambaqui Vila Paranaense)	120	80	9	40	23000	Oliverira (2000)
Sambaqui Gravatá	50	80	1,5	40	3772	Oliverira (2000)
Sambaqui Ilha dos Espinheiros I	70	40	1,5	20	944	Oliverira (2000)
Sambaqui Ilha dos Espinheiros II (Smabaqui Iate Clube)	80	40	5	20	3207	Oliverira (2000)
Sambaqui Morro do Amaral III (Sambaqui Ilha do Riacho)	200	170	10	85	114010	Oliverira (2000)
Sambaqui Fazendinha	35	45	4,5	22,5	3626	Oliverira (2000)
Sambaqui Ipiranga	80	30	2	15	711	Oliverira (2000)
Sambaqui Morro do Amaral IV	40	70	3	35	5787	Oliverira (2000)
Sambaqui Lagoa do Saguaçu (Sambaqui Caieira de Cima)	130	180	9	90	114889	Oliverira (2000)
Sambaqui Morro do Amaral I	80	50	1,5	25	1474	Oliverira (2000)
Sambaqui Morro do Amaral II	20	70	3,5	35	6757	Oliverira (2000)
Sambaqui Ilha do Mel II	50	25	3	12,5	750	Oliverira (2000)
Sambaqui Ilha do Mel III	110	40	1,5	20	944	Oliverira (2000)
Sambaqui Ilha do Mel I	40	60	4	30	5688	Oliverira (2000)
Sambaqui Guanabara II	34	30	1,5	15	532	Oliverira (2000)
Sambaqui Rio Riacho	40	50	1,5	25	1474	Oliverira (2000)
Casa de Pedra	8	9	0,38	4,5	12	Bandeira (2018)
Lagoa do Acaraí VII	13	30	1,5	15	532	Bandeira (2018)
Praia Grande IX	5	6	0,5	3	7	Bandeira (2018)
Praia Grande VI	15	25	2,5	12,5	622	Bandeira (2018)
Praia Grande VIII	13	21	1,3	10,5	226	Bandeira (2018)
Sambaqui da Ilha do Linguado I	100	200	2	100	31419	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Barra do Rio Saí-Mirim I	40	80	3	40	7554	Rohr (1984)
Sambaqui da Barra do Rio Saí-Mirim II		50	5	25	4974	Rohr (1984)
Sambaqui da Barranca do Rio Parati	50	100	6	50	23674	Rohr (1984)
Sambaqui da Bupeva I	50	100	10	50	39792	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Bupeva II	75	100	7	50	27668	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Bupeva III	50	100	3	50	11795	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Bupeva IV	50	100	10	50	39792	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Bupeva V	75	100	7	50	27668	Rohr (1984)
Sambaqui da Bupeva VI	50	50	10	25	10341	Rohr (1984)
Sambaqui da Bupeva VII	50	100	6	50	23674	Rohr (1984)
Sambaqui da Bupeva VIII	20	50	5	25	4974	Rohr (1984)
Sambaqui da Enseada	40	80	10	40	25656	Rohr (1984)
Sambaqui da Gamboa I	30	60	9	30	13105	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Gamboa II	30	60	8	30	11577	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Gamboa III	30	40	5	20	3207	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Gamboa IV	40	100	5	50	19700	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Guanabara	15	60	5	30	7134	Rohr (1984)
Sambaqui da Ilha do Linguado II	40	60	8	30	11577	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Ilha dos Papagaios	50	100	8	50	31683	Rohr (1984)
Sambaqui da Lagoa do Acarai I	150	150	12	75	106930	Rohr (1984)
Sambaqui da Lagoa do Acarai II	50	140	5	70	38549	Rohr (1984)
Sambaqui da Lagoa do Acarai III	40	60	7	30	10075	Rohr (1984)
Sambaqui da Lagoa do Acarai IV	50	200	7	100	110132	Rohr (1984)
Sambaqui da Lagoa do Acarai V	6	10	2	5	83	Rohr (1984)
Sambaqui da Lagoa do Acarai VI	100	100	20	50	82726	Rohr (1984)
Sambaqui da Praia Grande I	40	100	6	50	23674	Rohr (1984)
Sambaqui da Praia Grande II	100	100	15	50	60670	Rohr (1984)
Sambaqui da Praia Grande III	200	200	25	100	400868	Rohr (1984)
Sambaqui da Praia Grande IV	100	150	25	75	229068	Rohr (1984)

Sambaqui da Ribeira I	100	150	12	75	106930	Rohr (1984), Bigarella et al. (1954)
Sambaqui da Ribeira II	40	40	5	20	3207	Rohr (1984)
Sambaqui da Ribeira III	20	20	5	10	851	Rohr (1984)
Sambaqui da Ribeira IV	12	12	1,5	6	87	Rohr (1984)
Sambaqui da Ribeira V	15	15	3	7,5	279	Rohr (1984)
Sambaqui da Ribeira VI	20	30	6	15	2234	Rohr (1984)
Sambaqui da Tapera I	25	40	5	20	3207	Rohr (1984)
Sambaqui da Tapera II	30	30	5	15	1833	Rohr (1984)
Sambaqui da Tapera III	40	40	5	20	3207	Rohr (1984)
Sambaqui da Vila da Glória I	10	25	4	12,5	1015	Rohr (1984)
Sambaqui da Vila da Glória II	50	50	12	25	12685	Rohr (1984)
Sambaqui da Vila da Glória III	15	20	2	10	318	Rohr (1984)
Sambaqui de Areias Pequenas	80	170	15	85	171997	Rohr (1984)
Sambaqui de Forte Marechal Luz	40	50	6	25	6003	Rohr (1984)
Sambaqui de Jaguaruna I		60	20	30	32462	Rohr (1984)
Sambaqui de Jaguaruna II	10	60	2	30	2832	Rohr (1984)
Sambaqui de Jaguaruna III	20	60	2	30	2832	Rohr (1984)
Sambaqui de Jaguaruna IV	10	20	2	10	318	Rohr (1984)
Sambaqui de Jaguaruna V	40	70	6	35	11658	Rohr (1984)
Sambaqui de Porto do Rei I		30	1,5	15	532	Rohr (1984), Bigarella et al. (1954)
Sambaqui de Porto do Rei II	60	100	15	50	60670	Rohr (1984), Bigarella et al. (1954)
Sambaqui de Saí-Guaçu	60	100	17	50	69329	Rohr (1984)
Sambaqui do Capivaru I	30	30	5	15	1833	Rohr (1984)
Sambaqui do Capivaru II	10	10	3	5	132	Rohr (1984)
Sambaqui do Capivaru III	6	30	2	15	711	Rohr (1984)
Sambaqui do Capivaru IV	12	45	7	22,5	5746	Rohr (1984)
Sambaqui do Morro do Ouro	100	100	10	50	39792	Rohr (1984), Bigarella et al. (1954)
Sambaqui do Rio Perequê	30	140	10	70	77490	Bigarella et al. (1954)
Sambaqui do Piraí-Piranga		20	3	10	485	Rohr (1984)
Sambaqui do Rio Braço do Norte do Rio Saí-Mirim I	80	90	8	45	25714	Rohr (1984)
Sambaqui do Rio Braço do Norte do Rio Saí-Mirim II		100	5	50	19700	Rohr (1984)
Sambaqui do Rio Braço do Norte do Rio Saí-Mirim III	15	30	3	15	1074	Rohr (1984)
Sambaqui do Rio Paranaguá-Mirim I	15	50	5	25	4974	Rohr (1984)
Sambaqui do Rio Paranaguá-Mirim IV	15	30	4	15	1447	Rohr (1984)
Sambaqui do Rio Pinheiros I	45	90	8	45	25714	Rohr (1984)
Sambaqui do Rio Pinheiros II	47	65	15	32,5	26654	Rohr (1984), Bigarella et al. (1954)
Sambaqui do Rio Saí-Mirim I	70	100	20	50	82726	Rohr (1984)
Sambaqui do Rio Saí-Mirim II	15	30	2	15	711	Rohr (1984)
Sambaqui do Rio Saí-Mirim III	40	100	6	50	23674	Rohr (1984)
Sambaqui do Rio Saí-Mirim IV	50	80	4	40	10086	Rohr (1984)
Sambaqui da Barra do Sul	30	86	3	43	8727	Bigarella et al. (1954)
Sambaqui da Conquista	70	75	6,5	37,5	14501	Bigarella et al. (1954)
Sambaqui da Costeira	23	50	4,2	25	4162	Bigarella et al. (1954)
Sambaqui da Ilha dos Barcos I	30	70	1	35	1925	Bigarella et al. (1954)
Sambaqui da Ilha dos Barcos II	40	60	4	30	5688	Bigarella et al. (1954)
Sambaqui da Morretinha	40	50	10	25	10341	Bigarella et al. (1954)
Sambaqui de Areias Grandes	30	55	6	27,5	7240	Bigarella et al. (1954)
Sambaqui do Cacuruçú		45	8	22,5	6630	Bigarella et al. (1954)
Sambaqui do Rio Velho I - nº43	50	80	8	40	20374	Bigarella et al. (1954)
Sambaqui do Rio Velho II - nº44	30	50	8	25	8122	Bigarella et al. (1954)
Sambaqui Gamboa V - nº33	45	100	5	50	19700	Bigarella et al. (1954)
Sambaqui nº 10	15	25	3	12,5	750	Bigarella et al. (1954)
Sambaqui Espinheiros I (volume author estimation)	No data	No data	No data	no data	55000	Piazza (1966)
Sambaqui Espinheiros II	90	120	12	60	68761	Afonso e DeBlasis (1994)
Total (m3)					**3252673**	

Apêndice E – Artigo 1: Supplementary Information 1 – Subsistence Catches

Year	Total consumption (kg) using Eq. 5	Subsistence catches (kg) using Eq. 6	Subsistence catches (t) using Eq. 6	Subsistence catches (t) using Eq. 6 for Babitonga Bay	Professional and artisanal fishers (Santa Catarina state)	Sources
1950	70417	17815	18	2	2950	1950 (pg. 201) in 1948
1951	209483	52999	53	5	8776	1952 (pg. 207)
1952	209483	52999	53	5	8776	1953 (pg. 247) in 1951
1953	239583	60615	61	6	10037	1954 (pg. 231)
1954	249561	63139	63	6	10455	1955 (pg. 235)
1955	238628	60373	60	6	9997	1956 (pg. 176)
1956	228698	57861	58	5	9581	1957 (pg. 167)
1957	539223	136423	136	13	22590	1958 (pg.159)
1958	240610	60874	61	6	10080	1960 (pg. 47)
1959	254192	64310	64	6	10649	1961 (pg. 68)
1960	293096	74153	74	7	11968	1962 (pg. 53)
1961	444738	112519	113	10	18160	1963 (pg. 51)
1962	474763	120115	120	11	19386	1964 (pg. 77)
1963	501384	126850	127	12	20473	1965 (pg. 100)
1964	512674	129706	130	12	20934	1967 (pg. 95)
1965	538045	136125	136	13	21970	1967 (pg. 95)
1966	731100	184968	185	17	29853	1968 (pg. 107)
1967	753190	190557	191	18	30755	1970 (pg. 99)
1968	828105	209511	210	19	33814	1970 (pg. 99)
1969	828105	209511	210	19	33814	1971 (pg. 129) in 1968

Apêndice F – Artigo 1: Supplementary Information 1 – References

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Apêndice G – Artigo 1: Supplementary Information 2 – Calibration and modelling of radiocarbon dates for Cubatão I and Babitonga Bay

Calibration and modelling of radiocarbon dates for Cubatão I

```
Plot()
 {
  Sequence("Cubatao I")
  {
   Boundary("Start lower phase");
   Phase("Lower phase")
   {
    Sequence("A lower phase")
    {
     Curve("Marine13","Marine13.14c");
     Delta_R("LocalMarine",23,52);
     R_Date("Beta 259828", 3480, 60);
     Curve("SHCal13","SHCal13.14c");
     R_Date("Beta 259829", 3040, 60);
    };
    Sequence("B lower phase")
    {
     Curve("SHCal13","SHCal13.14c");
     R_Date("Beta 259826", 3110, 70);
     R_Date("Ly 4525", 2975, 30);
    };
    Curve("SHCal13","SHCal13.14c");
    R_Date("Beta 259825", 2970, 60);
    R_Date("Beta 259827", 2890, 70);
   };
   Boundary("End lower phase");
   Boundary("Start upper phase");
   Phase("Upper phase")
   {
    Curve("SHCal13","SHCal13.14c");
    Curve("Marine13","Marine13.14c");
    Delta_R("LocalMarine",23,52);
    Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
    R_Date("Beta 259820", 2670, 40);
    R_Date("Beta 259821", 2630, 40);
    Sequence("A upper phase")
    {
     Curve("SHCal13","SHCal13.14c");
     Curve("Marine13","Marine13.14c");
     Delta_R("LocalMarine",23,52);
     Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
     R_Date("Beta 268523", 2460, 40);
```

```
    Curve("Marine13","Marine13.14c");
    Delta_R("LocalMarine",23,52);
    R_Date("Beta 259823", 2560, 40);
   };
   Sequence("B upper phase")
   {
    Curve("SHCal13","SHCal13.14c");
    Curve("Marine13","Marine13.14c");
    Delta_R("LocalMarine",23,52);
    Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
    R_Date("Ly 4528", 2520, 30);
    R_Date("Ly 4527", 2495, 30);
    R_Date("Beta 268524", 2510, 40);
    Curve("Marine13","Marine13.14c");
    Delta_R("LocalMarine",23,52);
    R_Date("Beta 259824", 2660, 40);
    Curve("SHCal13","SHCal13.14c");
    Curve("Marine13","Marine13.14c");
    Delta_R("LocalMarine",23,52);
    Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
    R_Date("Ly 4524", 2460, 30);
    R_Date("Beta 268518", 2430, 40);
   };
   Sequence("C upper phase")
   {
    Curve("SHCal13","SHCal13.14c");
    Curve("Marine13","Marine13.14c");
    Delta_R("LocalMarine",23,52);
    Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
    R_Date("Beta 259519", 2520, 40);
    R_Date("Beta 268525", 2460, 40);
    R_Date("Ly 4526", 2620, 30);
   };
   Curve("SHCal13","SHCal13.14c");
   R_Date("Beta 268526", 2250, 40);
  };
  Boundary("End upper phase");
  Difference("Duration", "End upper phase", "Start upper phase");
Difference("duration Cubatao I", "End upper phase", "Start lower phase");
 };
};
```

Calibration and modelling of radiocarbon dates for Babitonga Bay

```
Plot( )
 {
```

```
Sequence("sambaquis")
{
 Boundary("start sambaquis");
 Phase("Sambaquis")
 {
  Phase("Casa de Pedra")
  {
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   R_Date("Beta 418377", 5470, 30);
   Curve("SHCal13","SHCal13.14c");
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
   R_Date("Beta 418378", 4460, 30);
  };
  phase ("Praia Grande XI(S2)")
  {
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   R_Date("Beta 452910", 5950, 30);
  };
  phase("Praia Grande VI")
  {
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   R_Date("Beta 452917", 5480, 30);
   R_Date("Beta 418380", 5270, 30);
   Curve("SHCal13","SHCal13.14c");
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
   R_Date("Beta 418379", 4690, 30);
  };
  phase ("Praia Grande IX")
  {
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   R_Date("Beta 446690", 5470, 30);
  };
  phase("Ribeirão do Cubatão")
  {
   Curve("Marine13","Marine13.14c");
   Delta_R("LocalMarine",23,52);
   R_Date("CEN 1131", 5040, 80);
   R_Date("CEN 1130", 4010, 70);
  };
```

```
phase("Rua Guaira")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("CEN 458", 5200, 70);
};
phase("Pernambuco")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("Beta 443871", 5030, 30);
};
phase("Rio Pinheiros II")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("no ID", 4580, 120);
 R_Date("no ID", 3850, 140);
};
phase("Rio Comprido")
{
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",74.4,4.4);
 R_Date("Beta 444033", 5090, 30);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",72.1,3.9);
 R_Date("AA 104771", 4320, 61);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",66.7,5.1);
 R_Date("Beta 448933", 3820, 30);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",65,5.3);
 R_Date("Beta 448932", 3510, 30);
};
phase("Cubatãozinho")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("CEN 1127", 4760, 80);
};
phase("Praia Grande II")
```

```
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 452915", 4700, 30);
 R_Date("no ID", 3850, 200);
};
phase("Praia Grande V")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 418381", 4670, 30);
};
phase("Lagoa do Saguacú")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("Beta 443870", 4630, 30);
};
phase("Morro do Ouro")
{
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 Mix_Curve("Mixed","SHCal13","LocalMarine",73.2,3.6);
 R_Date("AA104767", 4425, 39);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 Mix_Curve("Mixed","SHCal13","LocalMarine",63.7,5.6);
 R_Date("Beta 444034", 4200, 30);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 Mix_Curve("Mixed","SHCal13","LocalMarine",60.9,5.8);
 R_Date("AA104768", 4086, 42);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
 R_Date("Beta 93152", 4030, 40);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 Mix_Curve("Mixed","SHCal13","LocalMarine",3.7,2.7);
 R_Date("AA104770", 3938, 55);
};
phase("Lagoa do Acarai III (S12)")
{
```

```
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 R_Date("Beta 446686", 4240, 30);
};
phase("Forte Marechal Luz")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,50);
 R_Date("Birm 704", 4290, 130);
 Curve("SHCal13","SHCal13.14c");
 R_Date("M 1208", 3660, 130);
};
phase("Praia Grande IV")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446684)", 3980, 30);
 R_Date("Beta 453208", 3920, 30);
};
phase("Enseada I")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("no ID", 3920, 40);
};
phase("Cubatão III")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("no ID", 3930, 60);
 R_Date("no ID", 3930, 40);
 R_Date("no ID", 3680, 70);
 R_Date("CEN 1133", 3570, 70);
};
phase("Praia Grande III")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 452912)", 3870, 30);
};
phase("Lagoa do Acarai IV (S10)")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 418382", 3500, 30);
 R_Date("Beta 418383", 3450, 30);
 R_Date("Beta 452918", 3390, 30);
};
```

```
phase("Costeira")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("Beta 443868", 3960, 30);
};
phase("Praia Grande I")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 452920)", 3650, 30);
 R_Date("Beta 452914", 3640, 30);
};
phase("Bupeva VIII")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 452916", 3570, 30);
 R_Date("Beta 452919", 3450, 30);
};
phase("Lagoa do Acarai V (S11)")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446989", 3540, 30);
};
phase("Praia Grande VII")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 452913)", 3350, 30);
 R_Date("Beta 452911", 3330, 30);
};
phase("Lagoa do Acarai VII (S13)")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446688", 3290, 30);
};
phase("Praia do Ervino I")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446691", 3080, 80);
};
phase("Praia Grande VIII")
{
 Curve("Marine13","Marine13.14c");
```

```
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446683)", 3090, 30);
};
phase("Ilha dos Espinheiros II")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("St-8414", 3015, 130);
 R_Date("Gif-6167)", 3000, 95);
 R_Date("Gif-6166", 2730, 80);
};
phase("Cubatão I (lower sector)")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 259828", 3480, 60);
 Curve("SHCal13","SHCal13.14c");
 R_Date("Ly 4525", 3110, 70);
 R_Date("Beta 259829", 3040, 60);
 R_Date("Center base", 2975, 30);
 R_Date("Beta 259825", 2970, 60);
 R_Date("Beta 259827", 2890, 70);
};
phase("Espinheiros II")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("Gif 9416", 2970, 60);
};
phase("Perequê da Praia Grande")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446687", 2940, 30);
};
phase("Cubatão IV")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("CEN 1129", 2910, 70);
 R_Date("CEN 1128 ", 2750, 70);
};
phase("Guanabara I")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("Beta 443869", 2810, 30);
};
Phase("Bupeva VII")
{
```

```
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 397495", 2720, 30);
 R_Date("Beta 397496", 2710, 30);
};
phase("Cubatão I (upper sector)")
{
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
 R_Date("Beta 259820", 2670, 40);
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 259824", 2660, 40);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
 R_Date("Beta 259821", 2630, 40);
 R_Date("Ly 4526", 2620, 30);
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 259823", 2560, 40);
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
 R_Date("Beta 259519", 2520, 40);
 R_Date("Ly 4528", 2520, 30);
 R_Date("Beta 268524", 2510, 40);
 R_Date("Ly 4527", 2495, 30);
 R_Date("Beta 268525", 2460, 40);
 R_Date("Beta 268523", 2460, 40);
 R_Date("Ly 4524", 2460, 30);
 R_Date("Beta 268518", 2430, 40);
 Curve("SHCal13","SHCal13.14c");
 R_Date("Beta 268526", 2250, 40);
};
phase("Bupeva II")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("KIA 22262 ", 2325, 25);
};
phase("Guanabara II")
{
```

```
 Curve("SHCal13","SHCal13.14c");
 R_Date("Beta 96756", 2350, 120);
};
phase("Lagoa do Acarai I")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 446685)", 2350, 30);
};
phase("Ponta das Palmas")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("CEN 1134", 2430, 70);
};
Phase("Forte Marechal Luz")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("M 1207", 2060, 120);
};
Phase("Bupeva I")
{
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("Beta 397494", 1440, 30);
 R_Date("Beta 397493", 1390, 30);
};
Phase("Espinheiros II")
{
 Curve("SHCal13","SHCal13.14c");
 R_Date("no ID", 1270, 200);
 R_Date("Gif 9415", 1160, 45);
};
Phase("Rio Bucuriuma")
{
 Curve("SHCal13","SHCal13.14c");
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
 R_Date("no ID", 1340, 40);
 Curve("Marine13","Marine13.14c");
 Delta_R("LocalMarine",23,52);
 R_Date("no ID", 1190, 40);
};
Phase("Ilha dos Espinheiros II")
{
 Curve("SHCal13","SHCal13.14c");
```

```
     R_Date("Gif 6166", 1170, 200);
    };
    Phase("Rio Comprido")
    {
     Curve("SHCal13","SHCal13.14c");
     Curve("Marine13","Marine13.14c");
     Delta_R("LocalMarine",23,52);
     Mix_Curve("Mixed","SHCal13","LocalMarine",59.5,6);
     R_Date("Beta444032", 1140±30, 30);
    };
    Phase("Areias Pequenas")
    {
     Curve("SHCal13","SHCal13.14c");
     R_Date("Beta 443867", 780, 30);
    };
   };
  Boundary("end sambaquis");
  Difference("duration", "end sambaquis", "start sambaquis");
 };
 Sequence(ceramic)
 {
  Boundary("start ceramic");
  Phase("ceramic")
   {
    Phase("Itacoara")
    {
     Curve("SHCal13","SHCal13.14c");
     R_Date("KIA 21796", 1570, 20);
    };
    Phase("Forte Marechal Luz")
    {
     Curve("SHCal13","SHCal13.14c");
     R_Date("M 1206", 1440, 110);
     R_Date("M 1024", 1100, 100);
     R_Date("M 1202", 880, 100);
     R_Date("M 1205", 850, 100);
     R_Date("M 1200", 640, 100);
     R_Date("M 1203", 620, 10);
    };
    Phase("Ponta das Palmas")
    {
     Curve("SHCal13","SHCal13.14c");
     R_Date("CEN 1135", 600, 80);
    };
    Phase("Rio Pinheiros II")
    {
     Curve("SHCal13","SHCal13.14c");
```

```
    R_Date("Beta 443872", 860, 30);
   };
  };
  Boundary("end ceramic");
  Difference("duration", "end ceramic", "start sambaquis");
 };
 Difference("end sambaqui/start ceramic", "start ceramic", "end sambaquis");
};
```

SPD for Babitonga Bay

```
Sequence("Pre-Columbian coastal exploitation")
 {
 Boundary("start Pre-Columbian");
 Phase("Pre-Columbian")
  {
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  R_Date("Praia Grande XI (S2)", 5950, 30);
  R_Date("Praia Grande IX", 5470, 30);
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  R_Date("Casa de Pedra", 5470, 30);
  R_Date("Rua Guaira", 5200, 70);
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  R_Date("Praia Grande VI", 5480, 30);
  R_Date("Praia Grande VI", 5270, 30);
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  R_Date("Ribeirão do Cubatão", 5040, 80);
  Curve("SHCal13","SHCal13.14c");
  R_Date("Pernambuco", 5030, 30);
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  R_Date("Cubatãozinho", 4760, 80);
  R_Date("Praia Grande V", 4670, 30);
  Curve("SHCal13","SHCal13.14c");
  R_Date("Lagoa do Saguacú", 4630, 30);
  Curve("SHCal13","SHCal13.14c");
  Curve("Marine13","Marine13.14c");
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  Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
  R_Date("Praia Grande VI", 4690, 30);
  Curve("SHCal13","SHCal13.14c");
  Curve("Marine13","Marine13.14c");
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Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
R_Date("Casa de Pedra", 4460, 30);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",25,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",70.4,4.4);
R_Date("Rio Comprido", 5090, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Praia Grande II", 4700, 30);
Curve("SHCal13","SHCal13.14c");
R_Date("Rio Pinheiros II", 4580, 120);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",73.2,3.6);
R_Date("Morro do Ouro", 4425, 39);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",25,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",72.1,3.9);
R_Date("Rio Comprido", 4320, 61);
R_Date("Forte Marechal Luz", 4290, 130);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Lagoa do Acarai III (S12)", 4240, 30);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",63.7,5.6);
R_Date("Morro do Ouro", 4200, 30);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",60.9,5.8);
R_Date("Morro do Ouro", 4086, 42);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
R_Date("Morro do Ouro", 4030, 40);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Ribeirão do Cubatão", 4010, 70);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
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Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",3.7,2.7);
R_Date("Morro do Ouro", 3938, 55);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Praia Grande IV", 3980, 30);
R_Date("Praia Grande IV", 3920, 30);
Curve("SHCal13","SHCal13.14c");
R_Date("Enseada I", 3920, 40);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Cubatão III", 3930, 40);
R_Date("Cubatão III", 3930, 60);
R_Date("Cubatão III", 3680, 70);
R_Date("Cubatão III", 3570, 70);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",25,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",66.7,5.1);
R_Date("Rio Comprido", 3820, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Praia Grande III", 3870, 30);
Curve("SHCal13","SHCal13.14c");
R_Date("Costeira", 3860, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Praia Grande II", 3850, 200);
Curve("SHCal13","SHCal13.14c");
R_Date("Rio Pinheiros II", 3850, 140);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",25,52);
R_Date("Forte Marechal Luz", 3660, 130);
Curve("Marine13","Marine13.14c");
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R_Date("Praia Grande I", 3650, 30);
R_Date("Praia Grande I", 3640, 30);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",25,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",65,5.3);
R_Date("Rio Comprido", 3510, 30);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Lagoa do Acarai I", 3600, 180);
Curve("Marine13","Marine13.14c");
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Delta_R("LocalMarine",23,52);
R_Date("Bupeva VIII", 3570, 30);
R_Date("Bupeva VIII", 3450, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,50);
R_Date("Lagoa do Acarai V (S11)", 3540, 30);
R_Date("Lagoa do Acarai VII (S13)", 3290, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Survey S55E20 C", 3480, 60);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Lagoa do Acarai IV (S10)", 3500, 30);
R_Date("Lagoa do Acarai IV (S10)", 3450, 30);
R_Date("Lagoa do Acarai IV (S10)", 3390, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Praia Grande VII", 3350, 30);
R_Date("Praia Grande VII", 3330, 30);
Curve("SHCal13","SHCal13.14c");
R_Date("Ilha dos Espinheiros II", 3015, 130);
R_Date("Ilha dos Espinheiros II", 3000, 95);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,50);
R_Date("Praia Grande VIII", 3090, 30);
R_Date("Praia do Ervino I", 3080, 30);
R_Date("Perequê da Praia Grande", 2940, 30);
Curve("SHCal13","SHCal13.14c");
R_Date("Survey S55E20 F", 3040, 60);
R_Date("Center base 1", 3110, 70);
R_Date("Center base", 2975, 30);
R_Date("Grid N20W33", 2970, 60);
Curve("SHCal13","SHCal13.14c");
R_Date("Espinheiros II", 2970, 60);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Cubatao IV", 2910, 70);
R_Date("Survey S49E08", 2890, 70);
Curve("SHCal13","SHCal13.14c");
R_Date("Guanabara I", 2810, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Cubatao IV", 2750, 70);
Curve("SHCal13","SHCal13.14c");
R_Date("Ilha dos Espinheiros II", 2730, 80);
Curve("SHCal13","SHCal13.14c");
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Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,50);
Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
R_Date("Burial 8", 2670, 40);
R_Date("Burial 9", 2630, 40);
R_Date("Burial 5", 2620, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,50);
R_Date("Grid N17E02", 2660, 40);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,50);
Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
R_Date("Burial 7", 2520, 30);
R_Date("Burial 4", 2520, 40);
R_Date("Burial 12", 2510, 40);
R_Date("Burial 6", 2495, 30);
R_Date("Burial 1b", 2460, 30);
R_Date("Burial 14", 2460, 40);
R_Date("Burial 11", 2460, 40);
Curve("SHCal13","SHCal13.14c");
R_Date("Grid N09W12", 2250, 40);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
R_Date("Burial 1a", 2430, 40);
R_Date("Grid N05E01", 2560, 40);
Curve("SHCal13","SHCal13.14c");
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Ponta das Palmas", 2430, 70);
R_Date("Lagoa do Acarai I", 2350, 30);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Lagoa do Acarai II", 2350, 30);
Curve("SHCal13","SHCal13.14c");
R_Date("Guanabara II", 2350, 120);
Curve("Marine13","Marine13.14c");
Delta_R("LocalMarine",23,52);
R_Date("Bupeva II", 2325, 25);
Curve("SHCal13","SHCal13.14c");
R_Date("Forte Marechal Luz", 2060, 120);
Curve("SHCal13","SHCal13.14c");
R_Date("Itacoara", 1570, 20);
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  R_Date("Forte Marechal Luz", 1440, 110);
  Curve("SHCal13","SHCal13.14c");
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  Mix_Curve("Mixed","SHCal13","LocalMarine",56.8,0.8);
  R_Date("Rio Bucuriuma", 1340, 50);
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",23,52);
  R_Date("Rio Bucuriuma", 1190, 40);
  Curve("SHCal13","SHCal13.14c");
  R_Date("Espinheiros II", 1270, 60);
  R_Date("Espinheiros II", 1160, 45);
  R_Date("Ilha dos Espinheiros II", 1170, 200);
  Curve("SHCal13","SHCal13.14c");
  R_Date("Forte Marechal Luz", 1100, 100);
  Curve("SHCal13","SHCal13.14c");
  Curve("Marine13","Marine13.14c");
  Delta_R("LocalMarine",25,52);
  Mix_Curve("Mixed","SHCal13","LocalMarine",59.5,6);
  R_Date("Rio Comprido", 1140, 30);
  Curve("SHCal13","SHCal13.14c");
  R_Date("Forte Marechal Luz", 880, 100);
  R_Date("Forte Marechal Luz", 850, 100);
  R_Date("Rio Pinheiros II", 860, 30);
  Curve("SHCal13","SHCal13.14c");
  R_Date("Areias Pequenas", 780, 30);
  R_Date("Forte Marechal Luz", 620, 10);
  R_Date("Ponta das Palmas", 600, 80);
  Interval("Duration of Pre-Columbian coastal exploitation")
   };
 Boundary("end Pre-Columbian");
 Difference("Duration", "end Pre-Columbian", "start Pre-Columbian");
};
```

Apêndice H – Artigo 1: Supplementary Information 3 – Fauna in Areas A, B, and C

Area A - Grids N14, 15,16W1

Taxa (TL values)	Environment	D1, spit 1	D2, spit 1	D2, spit 2-3	D2, spite 4-5	D2, spit 6	D2, spit 7	D2, spit 8	D2, spit 9	D2, spit 10	D2, spit 11	D2, spit 12	**NISP**
Fish													
Actinopterrygii	Marine; Freshwater; Brackish	20	40	100	106	19	25	72	63	96	187	110	**838**
Strongylura spp. (3.0 to 4.5)	Marine; Freshwater; Brackish				1								**1**
Urophycis brasiliensis (3.9)	Marine		1	1									**2**
Perciformes (Lutjanidae, Sparidae or Haemulidae) (2.9 to 4.4)	Marine; Freshwater; Brackish	1	6	11	16	5	1	15	7	6	20	3	**91**
Oligoplites spp. (3.8 to 4.3)	Marine; Freshwater; Brackish							1					**1**
Selene vomer (4.3)	Marine; Brackish									1			**1**
Centropomus spp. (4.2)	Marine; Freshwater; Brackish		3	4	4			3	2	3	7	4	**30**
Ephippidae (4.5)	Marine; Brackish	1	1		2			1	1				**6**
Anisotremus spp. (3.6)	Marine	1			1		1	1	1				**5**
Mugilidae (2.0)	Marine; Freshwater; Brackish											1	**1**
Sciaenidae (3.1 to 4.1)	Marine; Freshwater; Brackish	2	7	8	3	4	1	2	2	2	9	4	**44**
Cynoscion spp. (3.1 to 4.1)	Marine; Freshwater; Brackish			1	2			1	2				**6**
Micropogonias furnieri (3.1)	Marine; Brackish			1	1	2		2	4	1	1	3	**15**
Pogonias cromis (3.4)	Marine; Brackish			2	1	1			5	2	6	3	**20**
Stellifer rastrifer (3.4)	Marine; Brackish											2	**2**
Pagrus pagrus (3.9)	Marine										1	1	**2**
Trichiurus spp. (4.4)	Marine; Brackish	1											**1**
Ariidae (3.5 to 3.8)	Marine; Brackish, Freshwater	1	4	15	21	4	7	9	14	16	23	12	**126**
Genidens spp. (3.6 to 3.8)	Marine; Brackish			1									**1**
Genidens barbus (3.8)	Marine; Brackish	1	1								6	5	**13**
Genidens genidens (3.6)	Marine; Brackish				3	2	3	6	4	2	1	5	**26**
Tetraodontidae (3.3 to 4.0)	Marine; Brackish	3	4	1	5		1			1	1	2	**18**
Chondrichthyes (2.6 to 4.9)	Marine; Freshwater; Brackish	3	2	12	6	1	2	2	2	1	1		**32**
Batoidea (2.6 to 4.5)	Marine; Brackish				1								**1**
Myliobatidae (3.2 to 3.3)	Marine; Brackish	2	6	14		2			1				**25**
NISP		**36**	**75**	**171**	**173**	**40**	**41**	**115**	**108**	**131**	**263**	**155**	
MNI		**15**	**24**	**20**	**32**	**14**	**12**	**22**	**24**	**18**	**21**	**25**	
NISP/m3		**69**	**453**	**635**	**955**	**205**	**242**	**716**	**929**	**1060**	**1886**	**2900**	

Area B - Grids N5,6W1; N5W2

Taxa (TL values)	Environment	D1, spit 1	D2, spit 1	D2, spit 2	D2, spit 3	D2, spit 4	D2, spit 5	D2, spit 6	D2, spit 7	D2, spit 8	D2, spit 9	D2, spit 10	D2, spit 11	D2, spit 12	**NISP**
Mammal															
Rodentia	Terrestrial			1											**1**
Tayassuidae	Terrestrial	6													**6**
Fish															
Actinopterygii	Marine; Freshwater; Brackish	82	11	8	23	33	19	162	89	126	183	250	62	140	**1188**
Perciformes (Lutjanidae, Sparidae or Haemulidae) (2.9 to 4.4)	Marine; Freshwater; Brackish	10	2		5	3	3	14	49	22	16	11	1	2	**138**
Centropomus spp. (4.2)	Marine; Freshwater; Brackish	2			1	4	3	2	2		2	8	4	5	**33**
Ephippidae (4.5)	Marine; Brackish	8			1				1			2			**12**
Chaetodipterus faber (4.5)	Marine; Brackish									1					**1**
Haemulidae (3.5 to 4.4)	Marine; Freshwater; Brackish							2							**2**
Anisotremus spp. (3.6)	Marine	13						2	5	2		2			**24**
Conodon nobilis (3.6)	Marine							1				1			**2**
Mugilidae (2.0)	Marine; Freshwater; Brackish	1	1		1		1	1	1		1				**7**
Pseudopercis spp. (3.9)	Marine				1										**1**
Sciaenidae (3.1 to 4.1)	Marine; Freshwater; Brackish	8	2			1	1	8		10	9	11	1	3	**54**
Cynoscion jamaicensis (3.8)	Marine; Brackish									1					**1**
Cynoscion leiarchus (3.1)	Marine; Brackish												1		**1**
Cynoscion spp. (3.1 to 4.1)	Marine; Freshwater; Brackish	2	1			1				1	4	1	1	1	**12**
Micropogonias furnieri (3.1)	Marine; Brackish	3								3	1	1	5		**13**
Pogonias cromis (3.4)	Marine; Brackish		1							1	3	6	5	3	**19**
Pleuronectiformes (3.2 to 4.0)	Marine; Freshwater; Brackish						1								**1**
Ariidae (3.5 to 3.8)	Marine; Freshwater; Brackish	1	3	1	6	6	4	31	12	26	53	65	34	22	**264**
Cathorops spixii (3.5)	Marine; Brackish										2			1	**3**
Genidens spp. (3.6 to 3.8)	Marine; Brackish											2			**2**
Genidens barbus (3.8)	Marine; Brackish						2	2			4	2	10	3	**23**
Genidens genidens (3.6)	Marine; Brackish	5				1		1	4	2	6	11	7		**37**
Rhamdia spp. (3.9)	Freshwater								2						**2**
Loricariidae (2.0 to 2.7)	Freshwater	1													**1**
Tetraodontidae (3.3 to 4.0)	Marine; Brackish	11		1	1	6		4	1	6	6	6	3	14	**59**
Chondrichthyes (2.6 to 4.9)	Marine; Freshwater; Brackish	35	3	1	4	1		2	1	2	14	17	3	4	**87**
Myliobatidae (3.2 to 3.3)	Marine; Brackish	2				2	2				2	26	1		35
NISP		**190**	**24**	**12**	**43**	**58**	**36**	**232**	**167**	**203**	**306**	**422**	**138**	**198**	
MNI		**32**	**11**	**5**	**12**	**13**	**8**	**22**	**18**	**24**	**35**	**27**	**27**	**15**	
NISP/m3		**623**	**218**	**171**	**391**	**483**	**257**	**3093**	**2750**	**2388**	**2604**	**5275**	**1022**	**2475**	

Area C - Grid N18W13

Taxa	Environment	D1, spit 1	D2, spit 1	D2, spit 2	D2, spit 3	D2, spit 4	D2, spit 5	D2, spit 6	**NISP**
Fish									
Actinopterygii	Marine; Freshwater; Brackish	41	30	60	226	164	294	191	**1006**
Strongylura spp. (3.0 to 4.5)	Marine; Freshwater; Brackish		1				1		**2**
Perciformes (Lutjanidae, Sparidae or Haemulidae) (2.9 to 4.4)	Marine; Freshwater; Brackish	3	4	4	12	5	27	5	**60**
Selene vomer (4.3)	Marine; Brackish						1		**1**
Centropomus spp. (4.2)	Marine; Freshwater; Brackish	1	2	4	5	17	15	8	**52**
Ephippidae (4.5)	Marine; Brackish				1		2	1	**4**
Anisotremus spp. (3.6)	Marine				1		1		**2**
Conodon nobilis (3.6)	Marine		1				2	1	**4**
Mugilidae (2.0)	Marine; Freshwater; Brackish	1				1	1		**3**
Pseudopercis spp. (3.9)	Marine					1	2		**3**
Pomatomus saltatrix (4.5)	Marine; Brackish	1				1			**2**
Sciaenidae (3.1 to 4.1)	Marine; Freshwater; Brackish	3			8	4	6	9	**30**
Cynoscion spp. (3.1 to 4.1)	Marine; Freshwater; Brackish	1				2	2	1	**6**
Micropogonias furnieri (3.1)	Marine; Brackish	1	3	2	3	1	6	6	**22**
Pogonias cromis (3.4)	Marine; Brackish	4		1	1		6	2	**14**
Ariidae (3.5 to 3.8)	Marine; Freshwater; Brackish	1	1	1	21	22	108	94	**248**
Genidens barbus (3.8)	Marine; Brackish			1			11	11	**23**
Genidens genidens (3.6)	Marine; Brackish							2	**2**
Tetraodontidae (3.3 to 4.0)	Marine; Brackish	12	14	8	19	16	83	4	**156**
Chondrichthyes (2.6 to 4.9)	Marine; Freshwater; Brackish	2			2	2	6	1	**13**
Batoidea (2.6 to 4.5)	Marine; Brackish						1		**1**
Myliobatidae (3.2 to 3.3)	Marine; Brackish			1	1			1	**3**
NISP		**71**	**56**	**82**	**300**	**236**	**575**	**337**	
MNI		**14**	**13**	**11**	**19**	**19**	**54**	**30**	
NISP/m3		**1014**	**2800**	**8200**	**7500**	**4720**	**5227**	**4213**	

Apêndice I – Artigo 1: Supplementary Information 3 – Fauna associated with human burials

Taxa (TL values)	**Burial 11**	**Burial 9**	**Burial 2**	**Burial 5**
Mammals				
Rodentia		1		
Fish				
Actinopterygii	291	172	144	246
Strongylura spp. (3.0 to 4.5)		1		
Perciformes (2.9 to 4.4)	9	20	29	53
Oligoplites spp. (3.8 to 4.3)		1		
Centropomus spp. (4.2)	22	6	7	6
Chaetodipterus faber (4.5)			1	
Ephippidae (4.5)		2		2
Anisotremus spp. (3.6)		2		2
Conodon nobilis (3.6)			1	1
Mugilidae (2.0)	2		2	
Pomatomus saltatrix (4.5)	1			
Sciaenidae (3.1 to 4.1)	9	8	14	13
Cynoscion spp. (3.1 to 4.1)	2	3	2	2
Micropogonias furnieri (3.1)	12	4	1	2
Pogonias cromis (3.4)	11	2	2	4
Pleuronectiformes (3.2 to 4.0)			1	
Ariidae (3.5 to 3.8)	84	30	62	53
Genidens spp. (3.6 to 3.8)				2
Genidens genidens (3.6)		13		11
Genidens barbus (3.8)	20		8	
Cathorops spixii (3.5)	3			
Rhamdia spp. (3.9)	1			
Tetraodontidae (3.3 to 4.0)	17	5	6	7
Chondrichthyes (2.6 to 4.9)	15	10	10	15
Batoidea (2.6 to 4.5)		1		
Myliobatidae (3.2 to 3.3)	6		3	26
NISP Total	**505**	**281**	**293**	**445**
MNI	**55**	**43**	**47**	**36**

Apêndice J – Artigo 2: Supplementary Information 1 – Sambaquis of Babitonga Bay discussed in the text with their respective cultural attribution, geographic coordinates and absolute chronology

Nº	Sambaquis	Cultural Attribution	Datum SIRGAS2000 zone 22S		Conventional Radiocarbon Age (BP)	Reference
			Longitude	Latitude		
1	Areias Grandes	Sambaqui	733120	7079189		Bigarella *et al.*,1954; Prous and Piazza, 1977; Souza *et al.*,2011; Bigarella *et al.*, 2011.
2	Areias Pequenas I	Sambaqui	730612	7081837	780 ± 30	Bigarella *et al.*,1954; Souza *et al.*, 2011; Bigarella *et al.*, 2011.
3	Barra do Sul	Sambaqui	738388	7070432		Bigarella *et al.*,1954; Prous and Piazza, 1977; Souza *et al.*, 2011.
4	Bupeva I	Sambaqui	738751	7073260	1.440 ± 30; 1.390 ± 30	Bigarella *et al.*,1954; Souza *et al.*, 2011.
5	Bupeva II	Sambaqui with ceramic	739187	7072550	2.325 ± 25; 375 ± 40	Bandeira, 2004; 2015; Ferreira, 2017; Souza *et al.*, 2011; Bandeira *et al.*, 2017.
6	Bupeva III	Sambaqui	738897	7073287	3.360 ± 30	Bigarella *et al.*,1954; Souza *et al.*, 2011.
7	Bupeva IV	Sambaqui	738926	7073187		Bigarella *et al.*,1954; Souza *et al.*, 2011.
8	Bupeva V	Sambaqui	738921	7073180		Bigarella *et al.*,1954; Souza *et al.*, 2011.
9	Bupeva VI	Sambaqui	738980	7072504		Ferreira, 2017; Bandeira *et al.*, 2017.
10	Bupeva VII	Sambaqui	738530	7073089	2.720 ± 30 2.710 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
11	Cacuruçu I	Sambaqui	735043	7079380		Bigarrela *et al.*,1954; Souza *et al.*, 2011.
12	Casa de Pedra	Sambaqui	743021	7084631	5.470 ± 30 4.460 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017; Bandeira *et al.*, 2018.
13	Conquista I	Sambaqui	732203	7076610		Bigarella *et al.*,1954; Prous and Piazza, 1977; Tiburtius, 1966; Souza *et al.*, 2011.
14	Costeira	Sambaqui	736247	7073543	3.860 ± 30	Bigarella *et al.*,1954; Souza *et al.*, 2011.
15	Cubatão I	Sambaqui	722580	7099810	3.480 ± 60; 2.250 ± 40	Figuti, 2009; Bandeira *et al.*, 2008; Bandeira *et al.*, 2009; Souza *et al.*, 2011; Fossile, 2013; Bigarella *et al.*, 2011; Zerger, 2009.
16	Cubatãozinho	Sambaqui with ceramic	721542	7097785	4.760 ± 80	Bigarella *et al.*,1954; Tiburtius and Bigarella, 1960; Souza *et al.*, 2011.
17	Tiburtius	Sambaqui	720082	7103872	3.330 ± 60 2.920 ± 50	Souza *et al.*, 2011.
18	Gamboa I	Sambaqui	736080	7081414		Bigarella *et al.*,1954; Souza *et al.*, 2011.
19	Gamboa II	Sambaqui	736124	7081354		Bigarella *et al.*,1954; Souza *et al.*, 2011.
20	Gamboa III	Sambaqui	736206	7081326		Bigarella *et al.*,1954; Souza *et al.*, 2011.
21	Gamboa IV	Sambaqui	736597	7081127		Bigarella *et al.*,1954; Souza *et al.*, 2011.
22	Edgard Tiburtius	Sambaqui	---	---		Tiburtius, 1966; Tiburtius and Bigarella, 1960.
23	nº 10	Sambaqui	736229	7073571		Bigarella *et al.*, 1954.
24	Enseada I	Sambaqui with ceramic	749766	7096002	3.920 ± 40; 1.390 ± 40	Bigarella *et al.*,1954; Bandeira, 1992; 2015; Beck, 1973; 2007; Tiburtius, 1996; Souza *et al.*, 2011.
25	Espinheiros I	Sambaqui	720361	7090950	2.920 ± 100 2.220 ± 210	Prous and Piazza, 1977; Piazza, 1966.
26	Espinheiros II	Sambaqui	720393	7090986	2.970 ± 60 1.160 ± 45	Figuti and Klökler, 1996; Afonso and DeBlasis, 1994; Souza *et al.*, 2011; Zerger, 2009.
27	Forte Marechal Luz	Sambaqui	746664	7103646	4.290 ± 130; 620 ± 10	Prous and Piazza, 1977; Bryan, 1993.
28	Ilha dos Barcos I	Sambaqui	727356	7085232		Bigarella *et al.*,1954; Souza *et al.*, 2011.
29	Ilha dos Barcos II	Sambaqui	727859	7085430		Bigarella *et al.*,1954; Souza *et al.*, 2011.
30	Ilha dos Espinheiros II	Sambaqui	721760	7090125	3.015 ± 130; 1.170 ± 200	Benz, 2000; Souza *et al.*, 2011.
31	Itacoara	Sambaqui with ceramic	713307	7077921	1.570 ± 20; 550 ± 55	Prous and Piazza, 1977; Bandeira, 2004; 2015; Bandeira *et al.*,2013; Tiburtius *et al.*,1951; Tiburtius and Bigarella, 1953; Bigarella *et al.*, 2011.
32	Lagoa do Acarai I	Sambaqui	744965	7089915	3.600 ± 180 2.350 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
33	Lagoa do Acarai II	Sambaqui	744961	7089878	2.350 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
34	Lagoa do Acarai VII	Sambaqui	745709	7091107	3.500 ± 30 3.390 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
35	Lagoa do Acarai VIII	Sambaqui	745417	7090616	4.240 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
36	Lagoa do Acarai IX	Sambaqui	745414	7090454	3.290 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
37	Lagoa do Acarai V	Sambaqui	745553	7090852	3.540 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
38	Lagoa do Acarai VI	Sambaqui	745769	7090183		Ferreira, 2017; Bandeira *et al.*, 2017.
39	Linguado I	Sambaqui	733059	7081919	2.590 ± 140	Bigarella *et al.*, 1954; Prous and Piazza, 1977; Souza *et al.*, 2011; Bigarella *et al.*, 2011.
40	Linguado II	Sambaqui	733263	7082050	2.830 ± 145	Bigarella *et al.*, 1954; Souza *et al.*, 2011; Bigarella *et al.*, 2011.
41	Moretinha	Sambaqui	733546	7082627		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
42	Morro do Ouro	Sambaqui	716903	7087677	4.030 ± 40	Bigarella *et al.*, 1954; Tiburtius and Bigarella, 1960; Prous and Piazza, 1977; Beck, 1973; 2007; Tiburtius, 1996; Goulart, 1980; Souza *et al.*, 2011; Bibow, 1997.
43	Pêreque Praia Grande	Sambaqui	738741	7077417	2940 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
44	Pernambuco	Sambaqui	732659	7079988	5.030 ± 30	Bigarella *et al.*, 1954; Souza *et al.*, 2011.
45	da Ribeira	Sambaqui	730226	7085989		Bigarella *et al.*, 1954; Souza *et al.*, 2011.

46	Porto do Rei I	Sambaqui	737711	7078365		Bigarella *et al.*, 1954; Souza *et al.*, 2011; Bigarella *et al.*, 2011.
47	Porto do Rei II	Sambaqui	737983	7078093		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
48	nº 42	Sambaqui	717310	7087186		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
49	Porto Grande	Sambaqui	724370	7076537		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
50	Praia Ervino I	Sambaqui	739684	7076218	3.080 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
51	Praia Grande I	Sambaqui	739616	7076941	3.650 ± 30 3.640 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
52	Praia Grande II	Sambaqui	742234	7081494	4.700 ± 30 3.850 ± 200	Ferreira, 2017; Bandeira *et al.*, 2017.
53	Praia Grande III	Sambaqui	742302	7081544	3.870 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
54	Praia Grande IV	Sambaqui	743421	7085198	3.980 ± 30 3.920 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
55	Praia Grande VI	Sambaqui	743298	7085459	5.480 ± 30 4.690 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
56	Praia Grande VII	Sambaqui	743612	7087278	3.350 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
57	Praia Grande IX	Sambaqui	743795	7086462	5.470 ± 30	Ferreira, 2017; Bandeira *et al.*, 2017.
58	Rio Parati I	Sambaqui	724056	7079349		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
59	Rio Parati II	Sambaqui	724143	7079555		Souza *et al.*, 2011.
60	Rio Parati III	Sambaqui	725134	7080347		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
61	Rio Parati IV	Sambaqui	725719	7081029		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
62	Rio Parati V	Sambaqui	725923	7081048		Bigarella *et al.*, 1954.
63	Rio Parati VI	Sambaqui	728240	7082351		Bigarella *et al.*, 1954.
64	Rio Parati VII	Sambaqui	727991	7082807		Bigarella *et al.*, 1954.
65	Rio Parati VIII	Sambaqui	728065	7083516		Bigarella *et al.*, 1954.
66	Rio Pereque	Sambaqui	734670	7070846	2.760 ± 160	Bigarella *et al.*, 1954; Souza *et al.*, 2011.
67	Rio Pinheiros I	Sambaqui	736090	7075740		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
68	Rio Pinheiros II	Sambaqui	735832	7075293	4.580 ± 120; 860 ± 30	Bigarella *et al.*, 1954; Prous and Piazza, 1977; Tiburtius *et al.*, 1954; Souza *et al.*, 2011.
69	Rio Velho I	Sambaqui	721264	7088175		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
70	Rio Velho II	Sambaqui	720890	7087619		Bigarella *et al.*, 1954; Souza *et al.*, 2011.
71	Praia Grande XI	Sambaqui	741599	7080623		Ferreira, 2017; Bandeira *et al.*, 2017.
72	Ilha do Gado II	Sambaqui	721772	7093651		Souza *et al*.,2011.
73	Ilha dos Espinheiros I	Sambaqui	721071	7090861		Souza *et al*.,2011.
74	Ilha dos Espinheiros III	Sambaqui	722373	7092036		Souza *et al.*, 2011; Bibow, 1997.
75	Ilha dos Espinheiros IV	Sambaqui	721695	7091811		Souza *et al*.,2011.
76	Morro do Amaral I	Sambaqui	722229	7088533		Souza *et al*.,2011.
77	Morro do Amaral II	Sambaqui	724207	7087958		Souza *et al*.,2011.
78	Lagoa do Saguaçu	Sambaqui	720079	7088417		Souza *et al*.,2011.
79	Cubatão II	Sambaqui	721843	7099889		Souza *et al*.,2011.
80	Cubatão III	Sambaqui	721639	7099772	3.930 ± 60; 3.570 ± 70	Souza *et al*.,2011.
81	Cubatão IV	Sambaqui	722511	7098551	2.910 ± 70; 2.750 ± 70	Souza *et al*.,2011.
82	Fazendinha*	Sambaqui	725561	7089471		Souza *et al*.,2011.
83	Gravatá*	Sambaqui	723531	7090806		Souza *et al*.,2011.
84	Guanabara I	Sambaqui	717305	7086918		Souza *et al*.,2011.
85	Ilha do Gado I	Sambaqui	721874	7093769		Souza *et al*.,2011.
86	Ilha do Gado III	Sambaqui	722122	7093724		Souza *et al*.,2011.
87	Ilha do Gado IV	Sambaqui	721717	7092819		Souza *et al*.,2011.
88	Ilha do Mel I	Sambaqui	726455	7087554		Souza *et al*.,2011.
89	Ilha do Mel II	Sambaqui	725909	7087783		Souza *et al*.,2011.
90	Ilha do Mel III	Sambaqui	726677	7087647		Souza *et al*.,2011.
91	Ipiranga	Sambaqui	724437	7089353		Souza *et al*.,2011.
92	Harmonia Lyra	Sambaqui	714924	7089210		Tiburtius *et al.*, 1954; Bigarella *et al.*, 2011.
93	Ponta das Palmas	Sambaqui	723666	7099922	2.430 ± 70 600 ± 80	Souza *et al*.,2011.
94	Ribeirão do Cubatão	Sambaqui	719204	7100122	5.040 ± 80 4.010 ± 70	Souza *et al*.,2011.
95	Rio Comprido	Sambaqui	718970	7091875		Souza *et al*.,2011.
96	Rio das Ostras	Sambaqui	719878	7104741	3.350 ± 60 2.040 ± 50	Souza *et al*.,2011.
97	Rio do Riacho	Sambaqui	723827	7087200		Souza *et al*.,2011.
98	Rio Fagundes	Sambaqui	718781	7103787		Souza *et al*.,2011.
99	Rio Ferreira	Sambaqui	718865	7106084		Souza *et al*.,2011.
100	Rio Pirabeiraba	Sambaqui	717615	7106497		Souza *et al*.,2011.
101	Rio Sambaqui	Sambaqui	720634	7104292		Souza *et al*.,2011.
102	Rua Guaíra	Sambaqui	718880	7094577		Souza *et al*.,2011.
103	Vila da Gloria III	Sambaqui	733738	7098375		Souza *et al*.,2011.
104	Cacuruçu II	Sambaqui	734766	7079202		Souza *et al*.,2011.
105	Cacuruçu III	Sambaqui	735043	7079238		Souza *et al*.,2011.
106	Vila da Gloria II (da Fábrica)	Sambaqui	733802	7098375		Souza *et al*.,2011.
107	Morro do Amaral III	Sambaqui	722159	7089527		Souza *et al*.,2011.
108	Morro do Amaral IV	Sambaqui	722596	7089335		Souza *et al*.,2011.
109	Guanabara II	Sambaqui	717062	7087269		Souza *et al*.,2011.
110	Rio Bacuruíuma I	Sambaqui	719599	7106365		Souza *et al*.,2011.

Apêndice K – Artigo 2: Supplementary Information 2 – Bibliographic sources and categories of the sambaqui sites in Babitonga Bay

Reference	Category	Classification
Afonso and DeBlasis, 1994	Article	Semi-quantitative
Bandeira *et al.*, 2008	Report	Semi-quantitative
Bandeira *et al.*, 2009	Article	Semi-quantitative
Bandeira *et al.*,2018	Article	Semi-quantitative
Beck, 1973	PhD thesis	Semi-quantitative
Beck, 2007	Book	Semi-quantitative
Figuti, 2009	Report	Semi-quantitative
Souza *et al.*, 2011	Book	Semi-quantitative
Tiburtius *et al.*, 1954	Article	Semi-quantitative
Tiburtius, 1996	Book	Semi-quantitative
Bandeira *et al.*, 2013	Article	Qualitative-quantitative
Bandeira *et al.*, 2017	Report	Qualitative-quantitative
Bandeira, 1992	Master dissertation	Qualitative-quantitative
Bandeira, 2004	PhD thesis	Qualitative-quantitative
Bandeira, 2015	Article	Qualitative-quantitative
Benz, 2000	Undergraduate thesis	Qualitative-quantitative
Bibow, 1997	Undergraduate thesis	Qualitative-quantitative
Bryan, 1993	Book	Qualitative-quantitative
Ferreira, 2017	Report	Qualitative-quantitative
Figuti and Klökler, 1996	Article	Qualitative-quantitative
Fossile, 2013	Undergraduate thesis	Qualitative-quantitative
Zerger, 2009	Undergraduate thesis	Qualitative-quantitative
Bigarella *et al.*, 1954	Article	Qualitative
Bigarella *et al.*, 2011	Book	Qualitative
Goulart, 1980	Report	Qualitative
Piazza, 1966	Article	Qualitative
Prous and Piazza, 1977	Article	Qualitative
Tiburtius and Bigarella, 1953	Article	Qualitative
Tiburtius and Bigarella, 1960	Article	Qualitative
Tiburtius *et al.*, 1951	Article	Qualitative
Tiburtius, 1966	Article	Qualitative

Apêndice L – Artigo 2: Supplementary Information 3 – Checklist of identified taxa in *sambaqui* sites of Babitonga Bay. M, marine; B, brackish; F, freshwater; FO, frequency of species; *, exotic species. Conservation status according to IUCN Red List and decrees 444/2014 and 445/2014 of Brazil's Ministry of the Environment (*Ministério do Meio Ambiente – MMA*).

Taxonomy	Common Name	Systems	*Status*		Sambaquis	FO	Reference
			IUCN	MMA			
Annelida							
Polychaeta							
Sabellida							
Serpulidae							
Sp. 1	----	M			13.	0.91%	TIBURTIUS, 1966.
Mollusca							
Bivalvia							
Lucinida							
Lucinidae							
Clathrolucina sp.	----	M			5; 9; 10.	2.73%	FERREIRA, 2017; BANDEIRA et al, 2017.
Phacoides pectinatus (Gmelin, 1791)	Thick lucine	M			1-6; 8-14; 18; 23-28; 30-36; 38-47; 50-60; 65; 67-69; 77; 78; 82; 83; 87; 104-106.	54.55%	BANDEIRA et al, 2013; BRYAN, 1993; PIAZZA, W. 1966; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; PROUS & PIAZZA, 1977; TIBURTIUS, 1966; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA, et al 2018.
Divalinga quadrisulcata (d'Orbigny, 1845)		M			42.	0.91%	SOUZA*et al*,2011.
Venerida							
Veneridae							
Amiantis purpurata (Lamarck, 1818)	---	M			2; 3; 23; 24; 27; 30; 31; 47; 68; 69; 110.	10.00%	BRYAN, 1993; TIBURTIUS et al, 1954; BIGARELLA et al, 1954; PROUS & PIAZZA, 1977; SOUZA et al, 2011; BIBOW, 1997.
Anomalocardia flexuosa(Linnaeus, 1767)	Carib pointed venus clam	M			1-21; 23-30; 32-91; 94-108; 110.	95.45%	AFONSO & DE BLASIS, 1994; FIGUTI, 2009; BANDEIRA, 2004; 1992; BRYAN, 1993; FIGUTI e KLOKLER, 1996; PIAZZA, W. 1966; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; BIGARELLA et al, 1954; PIAZZA & PROUS, 1977; TIBURTIUS, 1966; BANDEIRA et al, 2008; BANDEIRA et al, 2009; FERREIRA, 2017; TIBURTIUS & BIGARELLA, 1960; GOULART, 1980; SOUZA et al, 2011. BIGARELLA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2018; BANDEIRA et al, 2017; ZERGER, 2009.
Chione subrostrata (Lamarck, 1818)	Cross-barred venus	M			18; 42; 45; 61; 67.	4.55%	TIBURTIUS, 1996; BIGARELLA et al, 1954.
Chione pubera (Bory Saint-Vincent,1827)	----	M			13; 27; 42; 68.	3.64%	BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; PROUS & PIAZZA, 1977; TIBURTIUS, 1966; SOUZA et al, 2011.
Chionopsis crenata (Gmelin, 1791)		M			42.	0.91%	SOUZA et al, 2011.
Dosinia concentrica (Born, 1778)	----	M			24; 27; 30; 65.	3.64%	BRYAN, 1993; BIGARELLA et al, 1954; SOUZA et al, 2011; BIBOW, 1997.
Lamelliconcha circinata (Born, 1778)		M			26.	0.91%	SOUZA et al, 2011.

Leukoma antiqua (P. P. King, 1832)		M			26; 42; 76; 78.	3.64%	SOUZA et al, 2011.
Protothaca (=Leukoma) pectorina (Lamarck, 1818)	----	M			5; 30; 43; 26; 72.	4.55%	FERREIRA, 2017; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2017.
Pitar fulminatus (Menke, 1828)		M			3; 24; 42.	2.73%	SOUZA et al, 2011.
Tivela sp.	----	M			24; 30; 31; 42.	3.64%	BANDEIRA, 1992; PROUS & PIAZZA, 1977; BIBOW, 1997.
Tivela fulminata (Bory de Saint-Vincent, 1827)	----	M			27.	0.91%	BRYAN, 1993.
Tivela mactroides (Born, 1778)	----	M			39; 68.	1.82%	TIBURTIUS et al, 1954; BIGARELLA et al, 1954; SOUZA et al, 2011.
Tivela zonaria (Lamarck, 1818)	----	M			30.	0.91%	BIBOW, 1997
Tivela dentaria (Lamarck, 1818)		M			24.	0.91%	SOUZA et al, 2011.
Globivenus rigida (Dillwyn, 1817)		M			24.	0.91%	SOUZA et al, 2011.
Veneroida							
Chamidae							
Arcinella arcinella (Linnaeus, 1767)	----	M			47.	0.91%	BIGARELLA et al, 1954.
Arcinella brasiliana (Nicol, 1953)		M			47.	0.91%	SOUZA et al, 2011.
Mactridae							
Mactrellona alata (Spengler, 1802)	Caribbean winged mactra	M			24; 27; 42; 67.	3.64%	BRYAN, 1993; TIBURTIUS, 1996; SOUZA et al, 2011.
Mactrotoma fragilis (Gmelin, 1791)	Fragile surfclam	M			27.	0.91%	BRYAN, 1993.
Mesodesmatidae							
Amarilladesma mactroides (Reeve, 1854)		M			26; 42.	1.82%	SOUZA et al, 2011.
Cardiida							
Cardiidae							
Laevicardium brasilianum (Lamarck, 1819)	----	M			42.	0.91%	TIBURTIUS, 1996; SOUZA et al, 2011.
Dallocardia sp.	----	M			10; 52; 53.	1.82%	FERREIRA, 2017; BANDEIRA et al, 2017.
Dallocardia muricata (Linnaeus, 1758)	Yellow American Cockle	M			1-3; 5; 11; 13; 18; 23; 24; 26; 27; 39; 42; 45; 47; 60; 65; 67; 68; 104; 105.	19.09%	BANDEIRA, 2004; BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; TIBURTIUS, 1966; SOUZA*et al*,2011.
Donacidae							
Donax hanleyanus (Philippi, 1847)	Wedge clam	M			5; 24; 35; 43; 50-54; 57.	9.09%	BANDEIRA, 2004; 1992; FERREIRA, 2017; SOUZA et al, 2011; BANDEIRA et al, 2017.
Iphigenia brasiliensis (Lamarck, 1818)	Giant False Donax	M			3; 16; 24; 26; 27; 39; 42; 68.	7.27%	BANDEIRA, 1992; TIBURTIUS et al, 1954; BRYAN, 1993; BIGARELLA et al, 1954; ; SOUZA et al, 2011.
Psammobiidae							
Psammotella cruenta (Lightfoot, 1786)	Operculate Sanguin	M			27.	0.91%	BRYAN, 1993.
Solecurtidae							
Tagelus plebelus (Lightfoot, 1786)	Stout tagelus	M			5; 16; 24; 26; 27; 42; 68.	6.36%	TIBURTIUS et al, 1954; BANDEIRA, 2004; 1992; BRYAN, 1993; BIGARELLA et al, 1954; PIAZZA & PROUS, 1977; SOUZA et al, 2011.

Tellinidae							
Austromacoma constricta (Bruguière, 1792)	Constricted Macoma	M			3; 5; 24; 26; 27; 42; 44; 46; 68; 72.	9.09%	BANDEIRA, 2004; 1992; TIBURTIUS et al, 1954; BIGARELLA et al, 1954; SOUZA et al, 2011.
Austromacoma sp.	----	M			24.	0.91%	BANDEIRA, 1992; PROUS & PIAZZA, 1977.
Sp. 2 (Tellininae)	----	M			5; 9; 35; 43; 50-54; 56.	9.09%	FERREIRA, 2017; BANDEIRA et al, 2017.
Unionida							
Unionidae							
Diplodon sp.	----	M			31.	0.91%	BANDEIRA et al, 2013.
Arcida							
Arcidae							
Anadara sp.	----	M			24; 52; 53.	2.73%	BANDEIRA, 1992; FERREIRA, 2017; BANDEIRA et al, 2017.
Anadara auriculata (Lamarck, 1819)	----	M			2; 45; 47; 68.	3.64%	TIBURTIUS et al, 1954; BIGARELLA et al, 1954.
Anadara brasiliana (Lamarck, 1819)	Incongruous ark	M			5; 26; 27; 42; 45.	4.55%	BANDEIRA, 2004; BRYAN, 1993; BIGARELLA et al, 1954; SOUZA*et al*,2011.
Anadara notabilis (Röding, 1798)	Eared ark	M			24; 27; 45; 68.	3.64%	BRYAN, 1993; SOUZA et al, 2011.
Arca sp.	----	M			18.	0.91%	BIGARELLA et al, 1954.
Arca imbricata (Bruguière, 1789)	Mossy ark	M			2; 3; 6; 18; 24; 27; 38; 41; 42; 45; 68.	10.00%	TIBURTIUS et al, 1954; TIBURTIUS, 1996; BRYAN, 1993; BIGARELLA et al, 1954; FERREIRA, 2017; SOUZA et al, 2011; BANDEIRA et al, 2017.
Barbatia candida (Helbling, 1779)		M			24.	0.91%	SOUZA et al, 2011.
Lunarca ovalis (Bruguière, 1789)	Blood ark	M			2; 3; 6; 27; 39; 45; 47; 68.	7.27%	BRYAN, 1993; SOUZA et al, 2011.
Ostreida							
Ostreidae							
Sp. 3	---	M			5; 9; 10; 12; 15; 31-33; 35; 36; 38; 43; 51-57.	17.27%	FIGUTI, 2009; PROUS & PIAZZA, 1977; BANDEIRA et al, 2008; BANDEIRA et al, 2009; FERREIRA, 2017; BANDEIRA et al, 2018; BANDEIRA et al, 2017.
Crassostrea rhizophorae (Guilding, 1828)	Mangrove oyster	M			1; 2; 15-17; 24; 26; 30; 31; 39; 42; 44; 46; 67; 69; 70; 72-91; 93-102; 110.	42.73%	AFONSO & DE BLASIS, 1994; BANDEIRA et al, 2013; BANDEIRA, 1992; FIGUTI e KLOKLER, 1996; SOUZA et al, 2011. BIGARELLA et al, 2011; BIBOW, 1997; ZERGER, 2009.
Magallana ariakensis (Fujita, 1913)	Suminoe oyster	M			24.	0.91%	PIAZZA & PROUS, 1977.

Ostrea sp.	Oyster	M			2-8; 11; 13; 14; 15; 16; 18-21; 23-30; 39-42; 44-48; 58-62; 66-70.	39.09%	BANDEIRA, 2004; 1992; BRYAN, 1993; FIGUTI e KLOKLER, 1996; PIAZZA, W. 1966; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; 2011; PIAZZA & PROUS, 1977; TIBURTIUS, 1966; TIBURTIUS & BIGARELLA, 1960; GOULART, 1980; BIBOW, 1997; ZERGER, 2009.
Pinnidae							
Atrina rigida (Lightfoot, 1786)	Stiff penshell	M			27; 68; 42	2.73%	BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; SOUZA et al, 2011.
Atrina seminuda (Lamarck, 1819)		M			39; 68; 42.	2.73%	SOUZA et al, 2011.
Pectinida							
Pectinidae							
Euvola (= Pecten) ziczac (Linnaeus, 1758)	Bermuda Sand Scallop	M			68.	0.91%	TIBURTIUS et al, 1954; BIGARELLA et al, 1954; SOUZA et al, 2011.
Pteriidae							
Pinctada imbricata (Röding, 1798)	Akoya pearl oyster	M			24; 38; 42; 52; 53.	4.55%	BANDEIRA, 1992; TIBURTIUS, 1996; FERREIRA, 2017; SOUZA et al, 2011; BANDEIRA et al, 2017.
Myida							
Corbulidae							
Juliacorbula sp.	----	M			56.	0.91%	FERREIRA, 2017; BANDEIRA et al, 2017.
Pholadidae							
Sp. 25	----	M			5.	0.91%	FERREIRA, 2017; BANDEIRA et al, 2017.
Cyrtopleura costata (Linnaeus, 1758)	Ngel wing clam	M			2; 5; 18; 24; 27; 39-41; 67; 68; 91.	10.00%	BRYAN, 1993; TIBURTIUS et al, 1954; BANDEIRA, 2004; BIGARELLA et al, 1954; SOUZA et al, 2011.
Pholas campechiensis (Gmelin, 1791)		M			2.	0.91%	SOUZA et al, 2011.
Mytilida							
Mytilidae							
Sp. 4		M			5.	0.91%	BANDEIRA, 2004.
Brachidontes darwinianus (d'Orbigny, 1842)	Mussel	M			30; 68.	1.82%	TIBURTIUS et al, 1954; BIGARELLA et al, 1954; BIBOW, 1997.
Brachidontes exustus (Linnaeus, 1758)	Mussel	M			12; 24; 26; 68; 69.	4.55%	FERREIRA, 2017; SOUZA et al, 2011; BANDEIRA et al, 2017.
Modiolus sp.	Mussel	M			42.	0.91%	GOULART, 1980.
Mytella sp.	Mussel	M			12; 15; 26; 42; 56.	4.55%	FIGUTI, 2009; FIGUTI e KLOKLER, 1996; FERREIRA, 2017; BIBOW, 1997; BANDEIRA et al, 2017; ZERGER, 2009.
Mytella brasiliensis(Gray, 1825)	Mussel	M			39	0.91%	BIGARELLA*et al*,2011.

Mytella guyanensis (Lamarck, 1819)	Mangrove mussel	M			1; 14; 16; 18; 19; 24-28; 30; 42; 58; 59; 61; 63; 65; 67; 68; 72.	18.18%	AFONSO & DE BLASIS, 1994; FIGUTI e KLOKLER, 1996; BRYAN, 1993; PIAZZA, W. 1966; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; PIAZZA & PROUS, 1977; TIBURTIUS & BIGARELLA, 1960; SOUZA et al, 2011.
Mytella charruana (d'Orbigny, 1842)		M			24.	0.91%	SOUZA et al, 2011.
Mytilus sp.	Mussel	M			25.	0.91%	PIAZZA, W. 1966.
Perna perna (Linnaeus, 1758)	Brown mussel	M			5; 24.	1.82%	BANDEIRA, 2004; 1992.
Teredinidae							
Sp. 5	----	M			27.	0.91%	BRYAN, 1993.
Gastropoda							
Caenogastropoda							
Ampullariidae							
Pomacea sp.	Applesnail	F			31.	0.91%	BANDEIRA et al, 2013.
Cerithiidae							
Cerithium atratum (Born, 1778)	Dark cerith	M			5; 9; 10; 12; 14; 24; 26; 27; 30; 34-38; 42; 52-54; 56; 57; 61; 67-70; 76; 78.	24.55%	BANDEIRA, 2004; 1992; BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; FERREIRA, 2017; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2018; BANDEIRA et al, 2017.
Colina macrostoma (Hinds, 1844)	----	M			42	0.91%	TIBURTIUS, 1996.
Neogastropoda							
Columbellidae							
Costoanachis sertulariarum (d'Orbigny, 1839)	well-ribbed dovesnail	M			*56*	0.91%	FERREIRA, 2017; BANDEIRA et al, 2017.
Nassariidae							
Nassarius sp. (Duméril, 1805)	nassa mud snails	M			2; 5; 24.	2.73%	BANDEIRA, 2004; 1992; BIGARELLA et al, 1954.
Phrontis antillarum (d'Orbigny, 1847)	Antilles nassa	M			42.	0.91%	TIBURTIUS, 1996.
Phrontis polygonata (Lamarck, 1822)	Sea snail	M			42; 59; 61.	2.73%	TIBURTIUS, 1996; BIGARELLA et al, 1954.
Phrontis vibex (Say, 1822)	Bruised nassa	M			2; 5; 9-12; 15-17; 26; 27; 30; 32-38; 42; 43; 50-57; 61; 69; 71; 72; 76-82; 84-88; 90; 91; 93; 94; 96; 98-101; 107; 108; 110.	52.73%	BRYAN, 1993; FERREIRA, 2017; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2018; BANDEIRA et al, 2017.
Conidae							
Conus sp.	----	M			27.	0.91%	BRYAN, 1993.
Conus clerii (Reeve, 1844)					24.	0.91%	SOUZA et al, 2011.
Conus regius (Gmelin, 1791)	Crown cone	M			27; 42.	1.82%	BRYAN, 1993; TIBURTIUS, 1996.
Terebridae							
Impages cinerea (Born, 1778)	Grey Atlantic auger	M			27; 24.	0.91%	BRYAN, 1993; SOUZA et al, 2011.

Terebra taurina (Lightfoot, 1786)	Flame auger	M			13; 42; 68.	2.73%	TIBURTIUS et al, 1954; TIBURTIUS, 1996; 1966; BIGARELLA et al, 1954; SOUZA et al, 2011.
Muricidae							
Siratus senegalensis (Gmelin, 1791)	Senegal Murex	M			5; 9; 10; 12; 24; 27; 34; 36-38; 42; 47; 51-53; 56; 57; 68.	16.36%	BANDEIRA, 2004; 1992; BRYAN, 1993; TIBURTIUS et al, 1954;TIBURTIUS, 1996; BIGARELLA et al, 1954; FERREIRA, 2017; SOUZA et al, 2011; BANDEIRA et al, 2018; BANDEIRA et al, 2017.
Stramonita brasiliensis (Claremont & D. G. Reid, 2011)	red-mouthed rock shell	M			1; 2; 5; 9; 12; 24; 27; 30; 35; 38; 42; 43; 47; 51-54; 56; 57; 67-69.	20.00%	BANDEIRA, 2004; 1992; BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; FERREIRA, 2017; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2017.
Olividae							
Oliva sp.	----	M			27.	0.91%	BRYAN, 1993.
Olivancillaria sp.	Orange-mouth olive	M			24; 42.	1.82%	BANDEIRA, 1992; PROUS & PIAZZA, 1977; BIBOW, 1997.
Olivancillaria auricularia (Lamarck, 1811)	Ureta's olive	M			24; 27; 68.	2.73%	BRYAN, 1993; TIBURTIUS et al, 1954; ; SOUZA et al, 2011.
Olivancillaria vesica (Gmelin, 1791)		M			13; 24; 26; 42; 67.	4.55%	SOUZA et al, 2011.
Olivancillaria urceus (Röding, 1798)	----	M			1; 24; 27; 43; 68.	4.55%	BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; SOUZA et al, 2011.
Olivella sp.	----	M			5; 15; 42.	2.73%	FIGUTI, 2009; BANDEIRA, 2004; BIBOW, 1997.
Olivella mutica (Say, 1822)	----	M			16; 42; 68.	2.73%	TIBURTIUS, 1996; PROUS & PIAZZA, 1977; TIBURTIUS & BIGARELLA, 1960; SOUZA et al, 2011.
Volutideae							
Zidona dufresnei (Donovan, 1823)		M			13; 24.	1.82%	SOUZA et al, 2011.
Cycloneritida							
Neritidae							
Neritina virginea (Linnaeus, 1758)	Virgin Nerite	M			5; 9; 10; 12; 15; 24; 26; 27; 30; 34; 36-38; 42; 43; 50-53; 61; 67-69; 71-73; 76-80; 86; 87; 99; 100; 108.	32.73%	BANDEIRA, 2004; 1992; BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; FERREIRA, 2017; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2018; BANDEIRA et al, 2017.
Lepetellida							
Fissurellidae							
sp.	----	M			56; 52; 53.	2.73%	FERREIRA, 2017; BANDEIRA et al, 2017.
Diodora patagonica (d'Orbigny, 1839)	Patagonian Keyhole Limpet	M			27.	0.91%	BRYAN, 1993.
Trochida							
Tegulidae							
Tegula viridula (Gmelin, 1791)		M			24.	0.91%	SOUZA*et al*, 2011.

Turbinidae							
Astralium latispina (Philippi, 1844)	star snails	M			24; 27.	1.82%	BRYAN, 1993; SOUZA*et al*, 2011.
Littorinimorpha						0.00%	
Caecidae						0.00%	
Caecum sp.	—	M			30.	0.91%	BIBOW, 1997.
Calyptraeidae							
Bostrycapulus aculeatus (Gmelin, 1791)	Spiny slipper snails	M			24; 38.	1.82%	FERREIRA, 2017; SOUZA et al, 2011; BANDEIRA et al, 2017.
Crepidula protea (d'Orbigny, 1841)	Slipper snails	M			5; 9; 56.	2.73%	FERREIRA, 2017; BANDEIRA et al, 2017.
Cypraeidae							
Macrocypraea zebra (Linnaeus, 1758)	Measled cowrie	M			13; 24; 27; 42; 43; 68.	5.45%	BRYAN, 1993; TIBURTIUS, 1996; TIBURTIUS*et al*,1954; TIBURTIUS, 1966; SOUZA*et al*,2011.
Cypraea sp.	—	M			42.	0.91%	BIBOW, 1997.
Cochliopidae							
Heleobia australis (d'Orbigny, 1835)		M, B			15; 26; 30; 74; 75; 78; 80; 81; 83; 84; 86; 91; 93-95; 97; 99; 102; 108; 110.	18.18%	SOUZA*et al*,2011.
Littorinidae							
Littoraria flava (King, 1832)	—	M			35; 43.	1.82%	FERREIRA, 2017; BANDEIRA et al, 2017.
Littorina sp.	—	M			30.	0.91%	BIBOW, 1997.
Naticidae							
Bulbus striatus (Golikov & Sirenko, 1983)	—	M			2; 40; 42; 47; 68.	4.55%	TIBURTIUS*et al*,1954; TIBURTIUS, 1996; BIGARELLA*et al*,1954.
Bulla striata (Bruguière, 1792)	Atlantic bubble	M			2; 5; 9; 12; 16; 17; 24; 26; 27; 30; 40-42; 47; 57; 68; 72; 76; 78; 90; 99; 100.	20.00%	BANDEIRA, 2004; 1992; BRYAN, 1993; FERREIRA, 2017; SOUZA et al, 2011; BIBOW, 1997; BANDEIRA et al, 2018; BANDEIRA et al, 2017.
Naticarius canrena (Linnaeus, 1758)		M			42.	0.91%	SOUZA*et al*,2011.
Polinices sp.	—	M			27; 42.	1.82%	BRYAN, 1993; BIBOW, 1997.
Polinices hepaticus (Röding, 1798)	Brown moonsnail	M			24; 27; 42; 68.	3.64%	BANDEIRA, 1992; BRYAN, 1993; TIBURTIUS*et al*,1954; TIBURTIUS, 1996; BIGARELLA*et al*,1954; PROUS & PIAZZA, 1977; SOUZA*et al*,2011.
Polinices lacteus (Guilding, 1834)		M			42.	0.91%	SOUZA*et al*,2011.
Rissoinidae							
Rissoina sp.	—	M			5.	0.91%	BANDEIRA, 2004.
Strombidae							
Strombus pugilis (Linnaeus, 1758)	West Indian fighting conch	M			2; 3; 8; 13; 24; 27; 42; 47; 67; 68.	9.09%	BRYAN, 1993; TIBURTIUS et al, 1954; BIGARELLA et al, 1954; BIGARELLA et al, 1954; SOUZA et al, 2011; BIBOW, 1997.
Cassidae							

Semicassis granulata (Born, 1778)	Scotch bonnet	M			27; 68; 42; 24.	3.64%	BRYAN, 1993; TIBURTIUS*et al*,1954; TIBURTIUS, 1996; BIGARELLA*et al*,1954; SOUZA*et al*,2011.
Phalium sp.	---	M			42.	0.91%	BIBOW, 1997.
Cassis tuberosa (Linnaeus, 1758)		M			13.	0.91%	SOUZA*et al*,2011.
Ranellidae							
Sp. 6 (Cymatiinae)	---	M			*35*	0.91%	FERREIRA, 2017; BANDEIRA et al, 2017.
Monoplex parthenopeus (Salis Marschlins, 1793)	Giant triton	M			2; 13; 14; 24; 27; 39; 41; 42; 47; 67; 68.	10.00%	BANDEIRA, 1992; BRYAN, 1993; TIBURTIUS et al, 1954; BIGARELLA et al, 1954; TIBURTIUS, 1966; SOUZA et al, 2011; BIBOW, 1997.
Tonnidae							
Tonna galea (Linnaeus, 1758)	Giant tun	M			2; 13; 14; 42; 43; 67; 68.	6.36%	TIBURTIUS*et al*,1954; TIBURTIUS, 1996; BIGARELLA*et al*,1954; TIBURTIUS , 1966; SOUZA*et al*,2011.
Tornidae							
Episcynia inornata (d'Orbigny, 1842)	Fringed vitrinella	M			5.	0.91%	BANDEIRA, 2004.
Vitrinella filifera (Pilsbry & McGinty, 1946)	Threaded vitrinella	M			5.	0.91%	BANDEIRA, 2004.
Hipponicidae							
Sp. 7	---	M			56.	0.91%	FERREIRA, 2017; BANDEIRA et al, 2017.
Vermetidae							
Petaloconchus sp.	---	M			9; 56.	1.82%	FERREIRA, 2017; BANDEIRA et al, 2017.
Sigmurethra							
Strophocheilidae							
Megalobulinus sp.	---	T			15; 30; 31; 42.	3.64%	FIGUTI, 2009; BIBOW, 1997.
Megalobulinus oblongus (Müller, 1774)	Giant South American snail	T			5; 6; 13; 24; 27; 31; 39; 40; 42; 59; 68.	10.00%	BRYAN, 1993; TIBURTIUS et al, 1954; TIBURTIUS, 1996; BIGARELLA et al, 1954; PROUS & PIAZZA, 1977; TIBURTIUS, 1966; BANDEIRA et al, 2013; FERREIRA, 2017; BANDEIRA et al, 2017.
Subulinidae							
Subulina sp.		T			27.	0.91%	BRYAN, 1993.
Subulina octona (Bruguière, 1792)**	Miniature Awlsnail	T			27.	0.91%	BRYAN, 1993.
Odontostomidae							
Odontostomus paulistus (Pilsbry, 1898)	---	T			27.	0.91%	BRYAN, 1993.
Arthropoda - Crustacea							
Malacostraca							
Decapoda							
Sp.	---	M			5; 12; 42; 68.	3.64%	TIBURTIUS et al, 1954; BANDEIRA, 2004; GOULART, 1980; BANDEIRA et al, 2018.

Portunidae							
Callinectes sp.	Atlantic blue crab	M			24.	0.91%	BANDEIRA, 1992.
Hexanauplia							
Sessilia							
Balanidae							
Balanus sp.	common barnacle	M			24.	0.91%	BANDEIRA, 1992.
Coronulidae							
Coronula sp.	Barnacle	M			24.	0.91%	BANDEIRA, 1992.
Chordata - Vertebrata							
Elasmobranchii							
Sp. 8 (Chondrichthyes)	Sharks or Rays	M,B			31; 42.	1.82%	PIAZZA & PROUS, 1977; TIBURTIUS*et al*,1951; BANDEIRA*et al*,2013; GOULART, 1980; BIGARELLA et al, 2011.
Sp. 9 (Batoidea)	Rays	M			15; 24; 31.	2.73%	FOSSILE, 2013; BANDEIRA, 1992.
Myliobatiformes							
Myliobatidae							
Aetobatus sp.	Spotted Eagle Ray	M			27.	0.91%	BANDEIRA, 2004; BRYAN, 1993.
Sp. 10	Ray	M			27; 30.	1.82%	BRYAN, 1993; BENZ, 2000.
Rajiformes							
Sp. 11	Ray	M			5; 31.	1.82%	TIBURTIUS*et al*,1951; BANDEIRA, 2004; BIGARELLA et al, 2011.
Carcharhiniformes							
Carcharhinidae							
Carcharhinus isodon (Müller & Henle, 1839)	Finetooth Shark	M	**LC**	**RE**	5; 31.	1.82%	BANDEIRA, 2004.
Galeocerdo cuvier (Péron & Lesueur, 1822)	Tiger Shark	M,B	**NT**		5; 24.	1.82%	BANDEIRA, 2004; 1992.
Prionace glauca (Linnaeus, 1758)	Blue Shark	M	**NT**		24	0.91%	BANDEIRA, 1992.
Sphyrnidae							
Sphyrna sp.	Shark	M,B			5; 24.	1.82%	BANDEIRA, 2004; 1992.
Lamniformes							
Alopiidae							
Alopias vulpinus (Bonnaterre, 1788)	Common Thresher Shark	M	**VU**	**VU**	30	0.91%	BENZ, 2000.
Lamnidae							
Carcharodon carcharias (Linnaeus, 1758)	Great White Shark	M,B	**VU**	**VU**	5; 24; 27.	2.73%	BANDEIRA, 2004; 1992; BRYAN, 1993.
Isurus oxyrinchus (Rafinesque, 1810)	Shortfin Mako	M	**VU**		5	0.91%	BANDEIRA, 2004.
Odontaspididae							
Carcharias sp.	Shark	M			27	0.91%	BRYAN, 1993.
Carcharias taurus (Rafinesque, 1810)	Sand Tiger Shark	M	**VU**	**CR**	5; 15; 24; 27; 30.	4.55%	BRYAN, 1993; BANDEIRA, 2004; 1992; FOSSILE, 2013; BENZ, 2000.

Actinopterygii							
Sp. 12	fish	-			42	0.91%	GOULART, 1980.
Anguilliformes							
Muraenidae							
Gymnothorax ocellatus (Agassiz, 1831)	Caribbean Ocellated Moray	M,B			5	0.91%	BANDEIRA, 2004.
Beloniformes							
Sp. 13	Fish	M			15	0.91%	FOSSILE, 2013.
Characiformes							
Erythrinidae							
Hoplias sp.	Trahira	M,F			31	0.91%	BANDEIRA et al, 2013.
Perciformes							
Carangidae							
Caranx sp.	kingfish	M			27.	0.91%	BANDEIRA, 2004; BRYAN, 1993.
Oligoplites sp.	Leatherjacket	M			26.	0.91%	FIGUTI e KLOKLER, 1996.
Selene vomer (Linnaeus, 1758)	Atlantic Lookdown	M			15.	0.91%	FOSSILE, 2013.
Centropomidae							
Centropomus parallelus (Poey, 1860)	Fat Snook	M,B,F			5; 15; 26.	2.73%	BANDEIRA, 2004; ; FIGUTI e KLOKLER, 1996; FOSSILE, 2013.
Centropomus undecimalis (Bloch, 1792)	Common Snook	M,B,F			24; 30.	1.82%	BENZ, 2000; BECK, 1973.
Ephippidae							
Chaetodipterus faber (Broussonet, 1782)	Atlantic Spadefish	M			5; 15; 24; 26; 27; 30.	5.45%	BANDEIRA, 2004; 1992; ; BRYAN, 1993; FIGUTI e KLOKLER, 1996; FOSSILE, 2013; BENZ, 2000.
Haemulidae							
Anisotremus surinamensis (Bloch, 1791)	Black Margate	M			5; 15.	1.82%	BANDEIRA, 2004; FOSSILE, 2013.
Conodon nobilis (Linnaeus, 1758)	Barred Grunt	M			5; 15; 24; 26; 30.	4.55%	PIAZZA & PROUS, 1977; BANDEIRA, 2004; 1992; FIGUTI e KLOKLER, 1996; BECK, 1973; BENZ, 2000.
Haemulon sp.	Grunt	M			24; 27.	1.82%	BANDEIRA, 2004; 1992; BRYAN, 1993.
Kyphosidae							
Kyphosus sectatrix(Linnaeus, 1758)	Bermuda sea chub	M			27.	0.91%	BANDEIRA, 2004; BRYAN, 1993.
Lutjanidae							
Lutjanus sp. (Bloch, 1790)	Golden African Snapper	M			5; 24.	1.82%	BANDEIRA, 2004; 1992.
Mugilidae							
Sp. 14	Mullet	M,B,F			15.	0.91%	FOSSILE, 2013.
Mugil liza (Valenciennes, 1836)	Blueback mullet	M,B,F			13; 24; 26; 27.	3.64%	PIAZZA & PROUS, 1977; TIBURTIUS , 1966; BANDEIRA, 1992; BRYAN, 1993; FIGUTI e KLOKLER, 1996.
Pinguipedidae							

Pseudopercis sp.	Namorado sandperch	M			15.	0.91%	FOSSILE, 2013.
Pomacanthidae							
Pomacanthus paru (Bloch, 1787)	French Angelfish	M			13.	0.91%	TIBURTIUS , 1966.
Pomatomidae							
Pomatomus saltatrix (Linnaeus, 1766)	Bluefish	M	VU		5; 15; 27.	2.73%	BANDEIRA, 2004; BRYAN, 1993; FOSSILE, 2013.
Sciaenidae							
Sp. 1	—	M,B			13.	0.91%	TIBURTIUS , 1966.
Bairdiella ronchus (Cuvier, 1830)	Ground Croaker	M			5; 26; 30.	2.73%	BANDEIRA, 2004; FIGUTI e KLOKLER, 1996; BENZ, 2000.
Cynoscion sp.	Gray weakfish	M,B			12; 15.	1.82%	FOSSILE, 2013; BANDEIRA et al, 2018
Cynoscion virescens (Cuvier, 1830)	Green Weakfish	M,B			26.	0.91%	FIGUTI e KLOKLER, 1996.
Cynoscion acoupa (Lacepède, 1801)	Acoupa Weakfish	M,B			24; 26.	1.82%	PIAZZA & PROUS, 1977; BANDEIRA, 1992; FIGUTI e KLOKLER, 1996.
Cynoscion jamaicensis (Vaillant & Bocourt, 1883)	Southern weakfish	M			5; 30.	1.82%	BANDEIRA, 2004; BENZ, 2000.
Cynoscion leiarchus (Cuvier, 1830)	Smooth Weakfish	M,B			26.	0.91%	FIGUTI e KLOKLER, 1996.
Isopisthus parvipinnis (Cuvier, 1830)	Bigtooth Corvina	M,B			26; 30.	1.82%	FIGUTI e KLOKLER, 1996; BENZ, 2000.
Larimus breviceps (Cuvier, 1830)	Shorthead Drum	M			24; 26; 30.	2.73%	FIGUTI e KLOKLER, 1996; ; BENZ, 2000.
Menticirrhus americanus (Linnaeus, 1758)	Southern Kingfish	M			30.	0.91%	BENZ, 2000.
Micropogonias furnieri (Desmarest, 1823)	Whitemouth Croaker	M			5; 15; 24; 26; 27; 30.	5.45%	PIAZZA & PROUS, 1977; BANDEIRA et al, 2008; BANDEIRA et al, 2009; BANDEIRA, 2004; 1992; BRYAN, 1993; FOSSILE, 2013; BECK, 1973; BENZ, 2000; ZERGER, 2009.
Nebris microps (Cuvier, 1830)	Smalleye Croaker	M,B			26.	0.91%	FIGUTI e KLOKLER, 1996.
Pogonias sp.	Drum	M, B			12.	0.91%	BANDEIRA et al, 2018.
Pogonias cromis (Linnaeus, 1766)	Black Drum	M,B			5; 15; 24-26; 30.	5.45%	PIAZZA & PROUS, 1977; BANDEIRA et al, 2008; BANDEIRA et al, 2009; BANDEIRA, 2004; 1992; FIGUTI e KLOKLER, 1996; FOSSILE, 2013; BECK, 1973; BENZ, 2000; ZERGER, 2009.
Stellifer sp.	Drum or Croaker	M,B			26.	0.91%	BENZ, 2000.
Stellifer rastrifer (Jordan, 1889)	Rake Stardrum	M,B			30.	0.91%	FIGUTI e KLOKLER, 1996.
Serranidae							
Sp. 15	----	M			27.	0.91%	BRYAN, 1993.
Hyporthodus niveatus (Valenciennes, 1828)	Snowy Grouper	M	VU	VU	24.	0.91%	BANDEIRA, 1992.
Epinephelus sp.	Hamlet	M			24.	0.91%	BANDEIRA, 1992.
Sparidae							
Archosargus probatocephalus (Walbaum, 1792)	Sheepshead	M,B			5; 24; 26; 27; 30.	4.55%	BANDEIRA, 2004; 1992; ; BRYAN, 1993; FIGUTI e KLOKLER, 1996; BENZ, 2000.
Diplodus argenteus (Valenciennes, 1830)	South-American Silver Porgy	M			27.	0.91%	BANDEIRA, 2004; BRYAN, 1993.

Pagrus pagrus (Linnaeus, 1758)	Red porgy	M			15; 27.	1.82%	BANDEIRA, 2004; BRYAN, 1993; FOSSILE, 2013.
Stromateidae							
Peprilus paru (Linnaeus, 1758)	American Harvestfish	M,B			24; 25; 68.	2.73%	BECK, 1973.
Trichiuridae							
Trichiurus lepturus (Linnaeus, 1758)	Largehead Hairtail	M,B			5; 24; 26; 27; 30; 31.	5.45%	BANDEIRA*et al*,2013; BANDEIRA, 2004; 1992; BRYAN, 1993; FIGUTI e KLOKLER, 1996.
Pleuronectiformes							
Sp. 16	----	M			15.	0.91%	FOSSILE, 2013.
Siluriformes							
Ariidae							
Sp. 1	----	M			15; 26; 31.	2.73%	BANDEIRA et al, 2008; BANDEIRA et al, 2009; BANDEIRA et al, 2013; FIGUTI e KLOKLER, 1996; FOSSILE, 2013; ZERGER, 2009.
Aspistor luniscutis (Valenciennes, 1840)	Sea catfish	M			24; 26; 30.	2.73%	FIGUTI e KLOKLER, 1996; PIAZZA & PROUS, 1977; BECK, 1973; BENZ, 2000.
Cathorops spixii (Spix & Agassiz, 1829)	Madmango sea catfish	M			15.	0.91%	FOSSILE, 2013.
Genidens sp.	Catfish	M, B			12.	0.91%	BANDEIRA et al, 2018
Genidens barbus (Lacepède, 1803)	White sea catfish	M, B		EN	15; 30.	1.82%	FOSSILE, 2013; BENZ, 2000.
Genidens genidens (Cuvier, 1829)	Guri Sea Catfish	M, B			15; 24.	1.82%	FOSSILE, 2013.
Bagre bagre (Linnaeus, 1766)	Coco Sea Catfish	M			24; 30.	1.82%	BECK, 1973; BENZ, 2000.
Heptapteridae							
Rhamdia sp.	Catfish	M,F			5; 15; 31.	2.73%	BANDEIRA*et al*,2013; BANDEIRA, 2004; ; FOSSILE, 2013.
Loricariidae							
Hypostomus sp.	Armored catfish	M			15; 31.	0.91%	BANDEIRA et al, 2013; FOSSILE, 2013.
Tetraodontiformes							
Diodontidae							
Diodon hystrix (Linnaeus, 1758)	Spot-fin Porcupinefish	M			5; 24; 27.	2.73%	BANDEIRA, 2004; 1992.
Tetraodontidae							
Lagocephalus laevigatus (Linnaeus, 1766)	Smooth Puffer	M			5; 15; 24; 26; 27.	4.55%	BANDEIRA, 2004; 1992; BRYAN, 1993; FOSSILE, 2013.
Sphoeroides sp.	Puffer	M,B			12.	0.91%	BANDEIRA et al, 2018.
Reptilia							
Crocodylia							
Alligatoridae							
Caiman latirostris (Daudin, 1802)	Broad-snouted Caiman	F			24; 27; 31.	2.73%	TIBURTIUS*et al*,1951; BANDEIRA*et al*,2013; BANDEIRA, 1992; BRYAN, 1993; BIGARELLA et al, 2011.
Squamata							

Teiidae							
Salvator merianae (Duméril & Bibron, 1839)	Black-and-white Tegu	T			24.	0.91%	BANDEIRA, 1992.
Testudines							
Cheloniidae							
Sp. 17	Sea turtle	M			27; 30; 31.	2.73%	BANDEIRA*et al*,2013; BRYAN, 1993; BENZ, 2000.
Chelidae							
Hydromedusa sp.	Brazilian Snake-necked Turtle	F;T			27.	0.91%	BRYAN, 1993.
Aves							
Sp. 18	Bird	T			24; 31; 42.	2.73%	PROUS & PIAZZA, 1977; GOULART, 1980.
Procellariiformes							
Diomedeidae							
Thalassarche melanophris (Temminck, 1828)	Black-browed Albatross	M	NT		24.	0.91%	BANDEIRA, 1992.
Sphenisciformes							
Spheniscidae							
Spheniscus magellanicus (Forster, 1781)	Magellanic Penguin	M	NT		24.	0.91%	BANDEIRA, 1992.
Mammalia							
Sp.19	Mammal	T			42	0.91%	GOULART, 1980.
Artiodactyla							
Tayassuidae							
Pecari tajacu (Linnaeus, 1758)	Collared Peccary	T			13; 24; 31; 68.	3.64%	PROUS & PIAZZA, 1977; TIBURTIUS*et al*,1954; TIBURTIUS*et al*,1951; TIBURTIUS & BIGARELLA, 1953; TIBURTIUS, 1966; BANDEIRA*et al*,2013; BANDEIRA, 1992; BIGARELLA et al, 2011.
Tayassu pecari (Link, 1795)	White-lipped Peccary	T	VU	VU	24; 27; 30; 31.	3.64%	*BANDEIRA et al, 2013*;BANDEIRA, 1992; BRYAN, 1993; BENZ, 2000.
Tayassu sp.	Peccary	T			5; 27; 31.	2.73%	BANDEIRA, 2004.
Cervidae							
Sp. 20	----	T			13.	0.91%	TIBURTIUS, 1966.
Mazama sp.	Brocket	T			27.	0.91%	BRYAN, 1993.
Mazama americana (Erxleben, 1777)	Red Brocket	T			24.	0.91%	BANDEIRA, 1992.
Ozotoceros bezoarticus (Linnaeus, 1758)	Pampas Deer	T	NT	VU	24.	0.91%	BANDEIRA, 1992.
Carnivora							
Felidae							
Sp. 21	----	T			31.	0.91%	TIBURTIUS et al, 1951; BIGARELLA et al, 2011.
Leopardus pardalis (Linnaeus, 1758)	Ocelot	T			24; 27; 31; 68.	3.64%	PROUS & PIAZZA, 1978; TIBURTIUS*et al*,1954; TIBURTIUS*et al*,1951; BANDEIRA, 1992; BRYAN, 1993; BIGARELLA et al, 2011.

Panthera onca (Linnaeus, 1758)	Jaguar	T	NT	VU	68.	0.91%	TIBURTIUS et al, 1954.
Puma concolor (Linnaeus, 1771)	Puma	T	LC	VU	27; 68.	1.82%	BRYAN, 1993; TIBURTIUS*et al*,1954.
Procyonidae							
Nasua nasua (Linnaeus, 1766)	South American Coati	T			24; 30.	1.82%	BANDEIRA, 1992; BENZ, 2000.
Procyon cancrivorus (G. Cuvier, 1798)	Crab-eating Raccoon	T			27; 30.	1.82%	BRYAN, 1993; BENZ, 2000.
Otariidae							
Sp. 22	----	M			13.	0.91%	TIBURTIUS, 1966.
Arctocephalus sp. (Cuvier, 1827)	South American Fur Seal	M			24.	0.91%	BANDEIRA, 1992.
Otaria flavescens (Shaw, 1800)	South American Sea Lion	M			24.	0.91%	BANDEIRA, 1992.
Cetacea							
Sp. 23	Whale, dolphin	M			1; 3; 5; 13; 14; 16; 22-24; 27; 30; 31; 39; 42; 47; 67; 68; 92.	16.36%	PROUS & PIAZZA, 1977; TIBURTIUS*et al*,1954; TIBURTIUS, 1966; TIBURTIUS & BIGARELLA, 1960; BIGARELLA*et al*,2011.
Delphinidae							
Delphinus sp.	Common Dolphin	M			24.	0.91%	BANDEIRA, 1992.
Steno (Sotalia) sp.	Dolphin	M			24.	0.91%	BANDEIRA, 1992.
Sotalia guianensis (Van Beneden, 1864)	Guiana Dolphin	M	DD	VU	27.	0.91%	BRYAN, 1993.
Tursiops sp.	Common Bottlenose Dolphin	M			24.	0.91%	BANDEIRA, 1992.
Cingulata							
Dasypodidae							
Dasypus novemcinctus (Linnaeus, 1758)	Nine-banded Armadillo	T			5; 24; 30.	2.73%	BANDEIRA, 2004; BANDEIRA, 1992; BENZ, 2000.
Didelphimorphia							
Didelphidae							
Didelphis sp.	Common Opossum	T			24; 30; 31.	2.73%	BANDEIRA*et al*,2013; BANDEIRA, 1992; BENZ, 2000.
Perissodactyla							
Tapiridae							
Tapirus terrestris (Linnaeus, 1758)	Lowland Tapir	T	VU	VU	13; 24; 27; 30; 31; 68.	5.45%	PROUS & PIAZZA, 1977; TIBURTIUS*et al*,1954; TIBURTIUS, 1966; BANDEIRA*et al*,2013; BANDEIRA, 1992; BRYAN, 1993; BENZ, 2000.
Pilosa							
Myrmecophagidae							
Tamandua tetradactyla (Linnaeus, 1758)	Southern Tamandua	T			24.	0.91%	BANDEIRA, 1992.
Primates							
Cebidae							
Alouatta guariba (Humboldt, 1812)	Brown Howler	T	LC	VU	31.	0.91%	BANDEIRA et al, 2013.
Sapajus apella (Linnaeus, 1758)	Margarita Island Capuchin	T			31.	0.91%	BANDEIRA et al, 2013.

Rodentia							
Sp. 24	Rodent	T			24.	0.91%	PROUS & PIAZZA, 1977.
Caviidae							
Cavia aperea (Erxleben, 1777)	Brazilian Guinea Pig	T			5; 13; 24; 31.	3.64%	TIBURTIUS, 1966; BANDEIRA*et al*,2013; BANDEIRA, 2004; BANDEIRA, 1992.
Hydrochoerus hydrochaeris (Linnaeus, 1766)	Capybara				5; 13; 24; 27; 30; 31; 68.	6.36%	PROUS & PIAZZA, 1977; TIBURTIUS*et al*,1954; TIBURTIUS*et al*,1951; TIBURTIUS, 1966; BANDEIRA*et al*,2013; BANDEIRA, 2004; BANDEIRA, 1992; BRYAN, 1993; BENZ, 2000; BIGARELLA et al, 2011.
Cuniculidae							
Cuniculus paca (Linnaeus, 1766)	Agouti	T			5; 13; 24; 27; 30; 31; 68.	6.36%	PROUS & PIAZZA, 1977; TIBURTIUS*et al*,1954; TIBURTIUS*et al*,1951; TIBURTIUS, 1966; BANDEIRA, 2004; 1992; BRYAN, 1993; BENZ, 2000; BIGARELLA et al, 2011.
Dasyproctidae							
Dasyprocta azarae (Lichtenstein, 1823)	Azara's Agouti	T			13; 24; 31; 68.	3.64%	PROUS & PIAZZA, 1977; TIBURTIUS*et al*,1954; TIBURTIUS , 1966; BANDEIRA*et al*,2013; BANDEIRA, 1992.
Dasyprocta leporina (Linnaeus, 1758)	Red-rumped Agouti	T			27.	0.91%	BRYAN, 1993.
Muridae							
Rattus norvegicus (Berkenhout, 1769)*	Brown Rat	T			24.	0.91%	BANDEIRA, 1992.

Apêndice L – Artigo 2: Supplementary Information 4 – References Checklist

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