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ETNOECOLOGIA DE CETÁCEOS EM COMUNIDADES DE PESCADORES DE SÃO SEBASTIÃO, SÃO PAULO

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Resumo

A Etnobiologia estuda as interações entre populações humanas e recursos naturais, enfocando a percepção e o conhecimento humano sobre os recursos naturais, a forma como estes são utilizados e as práticas de manejo desenvolvidas pelas sociedades. O conhecimento ecológico local (LEK, de 'local ecological knowlegde') tem sido muito útil na elaboração de sistemas de co-manejo envolvendo comunidades locais, instituições do governo e cientistas. Pesquisas sobre o conhecimento dos pescadores em relação à ecologia de baleias e golfinhos iniciaram-se no Brasil na década passada. Os principais objetivos deste estudo são registrar e avaliar o conhecimento dos pescadores de São Sebastião, litoral paulista, em relação à etnotaxonomia (classificação e nomenclatura) de cetáceos, bem como sobre a etnoecologia destes animais obtendo informações sobre áreas de ocorrência, habitat, sazonalidade, dieta, tamanho de grupo, reprodução, predadores e interações com a pesca. Os resultados demonstraram que os pescadores estudados percebem os cetáceos em função de sua saliência morfológica e cultural. As espécies mais reconhecidas e nomeadas por eles foram as de maior tamanho (*Eubalaena australis, Tursiops truncatus*), as acidentalmente capturadas em redes de espera (*Pontoporia blainvillei, Sotalia guianensis*) e as mais veiculadas em programas de televisão (*Megaptera novaeangliae, Orcinus orca*). Encontramos uma alta concordância entre o LEK dos pescadores estudados sobre a ecologia dos cetáceos, o conhecimento de pescadores de outras comunidades do sul e sudeste brasileiro, dados obtidos de pesquisas locais e da literatura científica. Isto demonstra que o conhecimento dos pescadores pode ser útil para a conservação dos cetáceos, especialmente das espécies pouco conhecidas, sugerindo novas linhas de pesquisa e apontando áreas críticas em relação à captura acidental destes animais. Além disto, os pescadores podem contribuir de forma valiosa na elaboração de estratégias alternativas em relação ao uso de redes de pesca, ao passo que sua participação em projetos e planos de manejo pode ser uma forma de valorização da cultura local.

Abstract

Ethnobiology, a branch of Human Ecology, is the study of the interactions between human population and natural resources, concerning human perception, knowledge, resource uses and management. Local ecological knowledge (LEK) has been empirically built by several human societies and transmitted through generations, shaping their culture. LEK has been especially useful to design systems of co-management involving local people, government institutions and scientists. Surveys on fishers' knowledge about cetaceans' ecology are relatively scarce around the world and in Brazil they have begun in the last decade. The main objectives of this study are to record and to evaluate the knowledge of the fishers from São Sebastião, in relation to cetaceans' folk taxonomy and bio-ecological aspects, recording their information about classification, nomenclature, occurrence areas, habitat, seasonality, diet, group size, reproduction, predators and interactions with fisheries. Our results showed that fishers' perception about cetaceans was highly influenced by phenotypic and cultural salience of the whales and dolphins. The most recognized and cited species were those of greater size (*Eubalaena australis, Tursiops truncatus*), the most frequently caught ones (*P. blainvillei* and *S. guianensis*) and the most exposed by media (*M. novaeangliae* and *O. orca*). The high concordance among the LEK of the fishers from São Sebastião on cetaceans, the knowledge of fishers from other communities of southern and southeastern Brazil, data obtained by local researchers and from literature indicates that fishers' knowledge could contribute to cetacean's conservation, especially in relation to the less studied cetacean's species, pointing out new lines of investigation as well as determining fishing grounds where incidental capture of cetaceans are more critical in the studied areas and indicating possible changes in gillnets operations in order to reduce cetaceans catches. Besides, fishers' participation in such researches and co-management plans can be a way to revive and valorize their local culture.

INTRODUÇÃO GERAL

I. Ecologia Humana, Etnobiologia e Conhecimento Ecológico Local

A Ecologia Humana estuda as inter-relações entre o homem e seu ambiente, bem como os processos que geram mudanças nestas relações. Esta ciência surgiu da aplicação de conceitos da Ecologia no estudo destas inter-relações, sob o foco de várias ciências, como a Geografia, a Antropologia, a Sociologia e a Psicologia. Inicialmente, estes estudos preocupavam-se em analisar o efeito do meio ambiente sobre a cultura e posteriormente passam a considerar o meio físico e a cultura como sistemas que interagem, afetando-se mutuamente e gerando adaptações nos seres humanos. Entender como o homem se adapta ao seu ambiente tem sido fundamental para o estudo da evolução humana, uma vez que a diversidade cultural encontrada em populações humanas sofre influência de sua adaptação à variadas condições ambientais (Bruhn 1974, Begossi *et al.* 2002, Kormondy e Brown 2002).

Entende-se por cultura um conjunto de conhecimentos e comportamentos compartilhados pelos integrantes de uma sociedade, que são transmitidos e modificados cumulativamente, causando mudanças evolutivas capazes de afetar o fenótipo de seus indivíduos (Richerson e Boyd 1992). Através da cultura os seres humanos interagem com o mundo exterior. A cultura pode ser transmitida, através de unidades culturais, por aprendizado ou por imitação. Tais unidades, denominadas memes, variantes culturais ou culturgens são instruções para a realização de comportamentos, que estão armazenadas em algum lugar como, por exemplo, o cérebro humano, livros, imagens, lugares e objetos, e são repassadas principalmente por imitação (Dawkins 1979, Lumsden e Wilson 1981, Boyd e Richerson 1985, Blackmore 1999).

Entretanto, o comportamento humano depende também das crenças dos indivíduos, de sua história, suas habilidades e recursos com os quais convivem. A cultura humana não é estática e sua alta flexibilidade reflete as mudanças no ambiente em que está inserida. Na realidade, a alta velocidade da mudança cultural, comparada à lenta velocidade da mudança genética possibilitou a capacidade de adpatação humana (Boyd e Richerson 1985). Por exemplo, os recursos disponíveis no ambiente, somados à habilidade humana, é que determinam as adaptações que irão surgir em uma sociedade (Wilson 1980, Campbell 1995). A resiliência ecológica é a quantidade de distúrbio que um sistema pode absorver antes de mudar para um estado de equilíbrio alternativo (Gunderson *et al.* 2002). Comportamentos culturais manifestados por algumas comunidades podem contribuir para a resiliência ecológica, por meio de práticas que aumentem a biodiversidade ou evitem a sobre-explotação dos recursos, como foi observado por Begossi (2003) em seus estudos sobre o manejo dos territórios de pesca realizado pelos pescadores artesanais do litoral dos Estados do Rio de Janeiro e de São Paulo.

Neste contexto, a Etnobiologia estuda o conhecimento biológico adquirido por sociedades humanas do passado e do presente, constituindo uma interface entre a Biologia e a Antropologia (Berlin 1992, Berkes 1999, Marques 2002). Seu foco está nas inter-relações entre os seres humanos e o ambiente ao seu redor, incluindo aspectos bióticos, como a fauna e a flora, e abióticos, como por exemplo, o clima, o solo e as correntes marinhas, dentre outros. No intuito de entender os processos mediadores destas inter-relações, a Etnobiologia analisa a percepção humana em relação aos elementos bióticos e abióticos do ambiente e seu modo de utilização dos recursos naturais (Begossi *et al*. 2002).

O conhecimento ecológico armazenado e desenvolvido por uma comunidade, também conhecido pela sigla LEK (‘local ecological knowledge’) é o objeto de estudo da Etnoecologia. Na medida em que o LEK é adquirido por uma comunidade e transmitido ao longo do tempo, mudanças

de comportamento resultantes deste conhecimento podem ocorrer influenciando diretamente no manejo de recursos por esta comunidade (Berkes *et al.* 2000). Alguns pesquisadores têm demonstrado que o LEK é importante para o estabelecimento de práticas de manejo adaptativo, no qual o conhecimento da comunidade em questão é utilizado no intuito de se testar estratégias alternativas de conservação, que são monitoradas e ajustadas ao longo do tempo, visando melhorar o manejo dos recursos naturais (Berkes *et al.* 2000). O conhecimento ecológico local também pode destacar variáveis ainda não contempladas em pesquisas científicas, gerar novas hipóteses, além de ser uma ferramenta para se diagnosticar mudanças ambientais em larga escala (Huntington *et* al. 1999, Berkes *et al*. 2000, Johannes *et al.* 2000, Gadgil *et al*. 2003). Desta forma, o LEK torna-se uma alternativa aos regimes de manejo 'de cima para baixo', instituído pelas instituições oficiais que determinam de que forma os recursos devem ser utilizados por comunidades vivendo no entorno de áreas protegidas. Em alguns países como: Alasca, Brasil, Canadá, Ilhas Salomão e Nova Zelândia, o LEK tem sido utilizado nos estudos e relatórios de impacto ambiental, bem como na implementação de estratégias alternativas de manejo pesqueiro (Ruddle 1995, Huntington *et al.* 1999, Johannes *et al.* 2000, Marques 2001, Davis e Wagner 2003, Begossi 2005, Silvano *et al.* 2007).

II. Objetivos Gerais e Específicos

Os objetivos gerais deste estudo são investigar a extensão do conhecimento dos pescadores de São Sebastião, no litoral paulista, acerca da ecologia e da taxonomia 'folk' de baleias e golfinhos, verificando o nível de informação dos pescadores em relação aos diferentes aspectos ecológicos tais como: áreas de ocorrência, habitat, sazonalidade, dieta, tamanho de grupo, reprodução, predadores e interações com a pesca, bem como analisando como os cetáceos são classificados e nomeados. Os objetivos específicos são investigar o conhecimento dos pescadores em relação às espécies de cetáceos mais comuns na área de estudo, a fim de verificar se algum dos aspectos ecológicos

estudados é mais percebido pelos pescadores em relação aos outros; comparar o conhecimento dos pescadores sobre os cetáceos ao conhecimento científico e a dados de pesquisa obtidos localmente, destacando as concordâncias e discordâncias entre estes dois tipos de conhecimento.

Em função das freqüentes interações entre os pescadores e os cetáceos durante as atividades pesqueiras, esperamos encontrar um conhecimento detalhado por parte dos pescadores estudados, em relação à etnoecologia e etnotaxonomia das espécies de cetáceos que ocorrem na área de estudo, em especial das espécies que são capturadas acidentalmente em redes de espera. Além disto, esperamos que os resultados deste estudo contribuam com informações importantes para a conservação dos cetáceos na área de estudo.

III. Área de estudo

O município de São Sebastião (23º42'18" a 23º45'38"S – 45º25'41" a 45º53'49"W) localiza-se no litoral norte do Estado de São Paulo, que compreende uma faixa litorânea de 161 Km, incluindo 164 praias e 17 ilhas. Os municípios vizinhos de São Sebastião são: Caraguatatuba ao norte, Ilhabela (a leste/sul) e Bertioga a oeste (Figura 1). Este litoral inclui-se no que se denomina de litoral sudeste ou das escarpas cristalinas, com planícies costeiras pouco desenvolvidas, ladeadas pela Serra do Mar, que nesta região apresenta espigões rochosos perpendiculares à linha de costa, formando um litoral com praias recortadas (SMA - SP, 1996). A linha de costa de São Sebastião inclui 34 praias, habitadas por cerca de 70.000 pessoas (IBGE 2006). Esta população pode se duplicar durante as férias de verão, devido ao intenso fluxo de turistas na região (CPTEC-INPE 2007). A região central do município abriga ainda o maior terminal petrolífero da América do Sul (TEBAR – TRANSPETRO), cujas atividades geram o mais expressivo aporte de renda ao município, seguidas por atividades turísticas e pesqueiras.

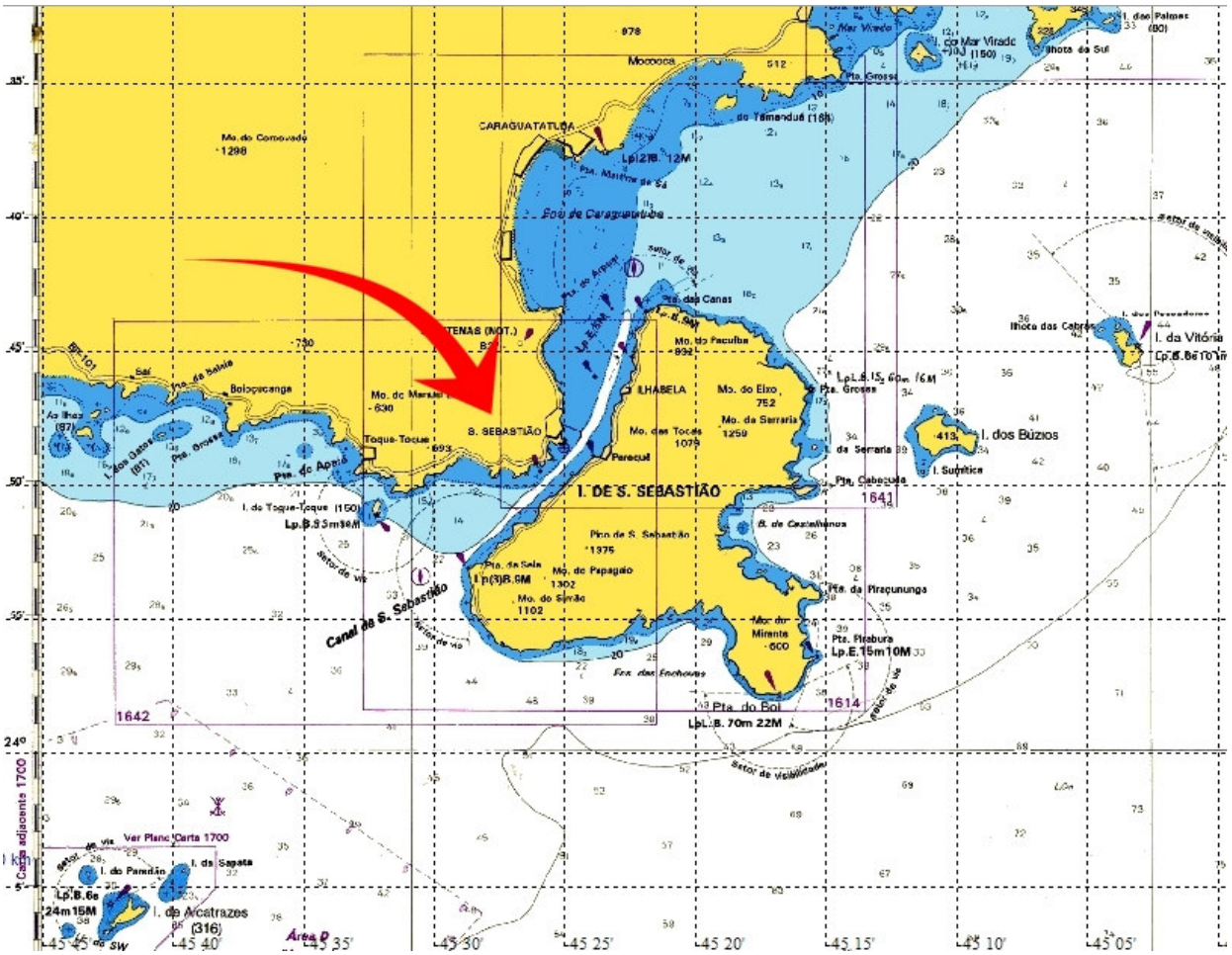

Figura 1. Carta náutica do litoral norte de São Paulo, mostrando São Sebastião e municípios vizinhos (DHN 1600).

A área estudada é fortemente influenciada por condições oceanográficas características do Canal de São Sebastião. A área ao norte deste Canal caracteriza-se por um litoral mais protegido, devido à presença da Ilha de São Sebastião (também conhecida por Ilhabela), enquanto que a área ao sudoeste do Canal caracteriza-se por litoral mais suscetível às ondulações oriundas do sul.

O litoral norte paulista é banhado pela massa de Água Costeira, que resulta da mistura das Massas de Água Tropical com a Massa de Água Central do Atlântico Sul, e apresenta temperaturas entre 19 e 29^{o}C e salinidade entre 32 a 36 ‰. Estudos oceanográficos relativos à circulação local, realizados desde a década de 1950 até o presente, evidenciam a formação de uma termoclina sazonal

e estratificação vertical em duas camadas durante o verão e o desaparecimento desta termoclina durante o inverno, quando as frentes polares atingem sua maior influência na região. Os ventos predominantes na região são de quadrante leste, seguidos pelos de quadrante sul (Silva 1995).

IV. Cetáceos na área de estudo

Baleias, golfinhos e botos são mamíferos altamente adaptados à vida aquática, pertencentes à Ordem Cetacea, subordens Mysticeti (cetáceos com cerdas bucais) e Odontoceti (cetáceos com dentes). Os cetáceos são considerados um dos grupos mais derivados entre todos os mamíferos, pois evoluíram de ancestrais terrestres, adaptando-se para uma vida totalmente aquática sem necessitar vir a terra para se reproduzir ou descansar (Jefferson *et al*. 1993). Atualmente são reconhecidas 86 espécies de cetáceos no mundo, sendo que para as águas brasileiras existem registros de 44 espécies, das quais algumas estão categorizadas sob certos graus de ameaça, segundo os critérios da IUCN, como: *Balaenoptera musculus* (em perigo), *Eubalaena australis*, *Balaenoptera physalus*, *Balaenoptera borealis, Megaptera novaeangliae*, *Physeter macrocephalus*, *Pontoporia blainvillei* e *Inia geoffrensis* (vulneráveis) (IBAMA 2001, Reeves *et al*. 2003).

De acordo com dados de pesquisas realizadas pelo 'Projeto SOS Mamíferos Marinhos'[1], de setembro de 1994 a novembro de 2006, 140 cetáceos de 16 espécies (*Megaptera novaeangliae, Balaenoptera edeni, B. acutorostrata, Eubalaena australis, Pontoporia blainvillei, Sotalia guianensis, Stenella frontalis, Tursiops truncatus, Steno bredanensis, Delphinus capensis, D. delphis, Kogia sima, Pseudorca crassidens, Orcinus orca, Berardius arnouxii* e *Mesoplodon mirus*) foram registrados, vivos ou mortos, no litoral norte paulista (Souza *et al*. 2005, Souza *et al*. 2006). Um maior detalhamento sobre aspectos bio-ecológicos das espécies de cetáceos na área de

[1] Projeto que pesquisa os cetáceos no litoral norte paulista há 12 anos, atualmente vinculado ao Instituto Terra & Mar (ONG sediada em São Sebastião, SP) e com apoio logístico do CEBIMar/USP.

estudo será fornecido no Capítulo 3 desta dissertação.

Baleias e golfinhos podem interagir acidentalmente e de forma negativa em atividades pesqueiras, resultando muitas vezes na morte destes animais ou causando danos aos equipamentos de pesca. A captura acidental de cetáceos ocorre principalmente em redes de espera, tendo também sido registrada, em menor escala, em pescarias utilizando espinhel, cerco e arrasto (Bertozzi e Zerbini 2002, Rosas *et al.* 2002, Santos *et al.* 2002). Di Beneditto *et al.* (2001) mencionam vários fatores relacionados ao comportamento alimentar dos cetáceos que contribuem para sua captura acidental, como a possibilidade das espécies predadas por estes animais serem espécies alvo da pesca comercial, a ocorrência de enredamento quando o animal está se deslocando em alta velocidade na perseguição de uma presa próxima a uma rede de espera, ou quando se alimenta em meio a grandes cardumes de peixes que prejudiquem a detecção visual e acústica da rede.

Em praticamente todos os países costeiros, registra-se ocorrência de capturas acidentais ou mesmo intencionais de cetáceos. O Peru era considerado, até poucos anos, como um dos países com o maior número de cetáceos capturados para consumo humano (Alfaro-Shigueto *et al.* 1996).

No Brasil, os estudos sobre as interações entre cetáceos e a atividade pesqueira tem sido realizados nos litorais do Ceará, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina e Rio Grande do Sul (Lodi e Capistrano 1990, Di Beneditto *et al*. 2001, Bertozzi e Zerbini 2002, Rosas *et al*. 2002, Freitas Netto 2003).

Espécies de hábitos mais costeiros, como *Pontoporia blainvillei* (toninha) e *Sotalia guianensis* (boto-cinza), são as mais vulneráveis aos enredamentos acidentais, fato este corroborado pelo monitoramento das capturas acidentais no litoral norte fluminense durante 15 anos de pesquisa, com registros de 323 ocorrências de captura acidental de toninha e boto-cinza, contra 21 registros de outras cinco espécies de golfinhos, somados aos 164 registros de indivíduos que não tiveram suas espécies identificadas (Di Beneditto *et al*. 2001).

Em geral, os cetáceos capturados em redes de pesca são descartados no mar, porém em algumas comunidades pesqueiras, especialmente no norte do Brasil tem sido eventualmente registrada a utilização de carcaças dos golfinhos capturados acidentalmente para diversos fins, tais como o consumo da carne para alimentação humana e/ou de cães, emprego do óleo obtido por meio do cozimento para impermeabilização das canoas e outros equipamentos, uso de pedaços de carne e gordura como iscas para colocar nas redes de pesca de tubarões ou a utilização dos olhos e de partes de órgãos genitais dos golfinhos como amuletos e em "simpatias" (Siciliano 1994, Flores 1994, Guiera e Zanelatto 1994, Fidélix *et al*. 1998).

Estudos sobre a etnobiologia de cetáceos podem contribuir para uma melhor caracterização das interações entre pescadores e cetáceos e indicar possíveis estratégias de manejo visando minimizar a captura acidental de cetáceos em redes de pesca.

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Capítulo 1

OS PESCADORES ARTESANAIS DE SÃO SEBASTIÃO, LITORAL DE SÃO PAULO

Pescadores rolando a canoa em direção ao rancho, na praia de Boiçucanga, São Sebastião.

Capítulo 1: Os pescadores artesanais de São Sebastião, litoral de São Paulo

1.1 Introdução

Os primeiros registros sobre a pesca artesanal no Brasil datam da época da colonização, quando os europeus verificaram que os habitantes nativos possuíam apetrechos e técnicas para praticá-la (Diegues 2005). A pesca artesanal pode ser considerada a pesca praticada em águas costeiras por pescadores que usam canoas e barcos de pequeno porte (até cerca de 10 m), utilizam técnicas pouco predatórias, variando de acordo com as espécies pescadas, a época do ano e as condições do mar, (Diegues 2005). Como atividade econômica, a pesca desenvolveu-se diferencialmente ao longo da costa brasileira, de acordo com as peculiaridades geográficas, climáticas e oceanográficas de cada parte deste litoral.

No litoral norte de São Paulo, onde se inclui São Sebastião, referências sobre a pesca artesanal realizada por habitantes nativos, denominados caiçaras, surgem no século XVIII, descrevendo o modo de vida local, que hoje se conhece como 'modo de vida caiçara', caracterizado pela pesca de pequena escala associada às roças de subsistência, especialmente ao cultivo da mandioca (Begossi 1999, Diegues 2005). O termo caiçara aplica-se aos habitantes nativos de comunidades costeiras desde o norte do Paraná até o sul do Rio de Janeiro, e remete a uma cultura própria, resultado da influência dos colonizadores europeus, dos índios e dos negros. Esta cultura se formou mediante suas relações com a natureza por meio da prática destas duas atividades: a pesca artesanal e a agricultura em pequena escala, sendo a agricultura a principal atividade de subsistência. A pesca passa a assumir maior importância entre os caiçaras a partir das primeiras décadas do século XX, em função do declínio da agricultura (Diegues 2005).

A partir da década de 1940, a pesca em escala industrial começa a ser praticada no litoral norte paulista com a chegada das traineiras para capturar cardumes de sardinha e com o início da

pesca de arrasto para captura de camarão. Desde aquela época, a realização da pesca de arrasto já era motivo de preocupação entre os pescadores da Ilhabela, sendo indicada como uma prática que degradava o meio ambiente marinho, como relata Mussolini (1945). Ainda hoje, esta é a maior preocupação dos pescadores artesanais locais, que agora sofrem os efeitos da devastação causada por este tipo de pesca, verificados pela redução dos estoques pesqueiros. Segundo relatório do Instituto de Pesca, a produção pesqueira do Estado de São Paulo nos últimos cinco anos tem se mantido estável entre 25 a 30 mil toneladas por ano, porém este total é de duas a três vezes inferior à produção registrada no início da década de 1990 (Ávila-da-Silva 2005). Além da frota pesqueira regional, embarcações de outros estados do Brasil, como Santa Catarina, vêm explorar recursos no litoral paulista. Neste caso, a maior parte destas embarcações opera com redes de parelha de grandes dimensões, conduzindo uma atividade de pesca em escala industrial, que se caracteriza pela utilização de barcos de médio e grande porte (de comprimento maior que 10 m), trabalhando com tripulação de até nove pescadores embarcados. Esse tipo de atividade utiliza, em geral, técnicas que exaurem os recursos pesqueiros em todo o litoral, não se preocupando com a sustentabilidade dos estoques pesqueiros (Secretaria do Meio Ambiente, 1996). Berkes (1985) aponta a pesca industrial como uma exploração destrutiva, com duas conseqüências inter-relacionadas: a degradação permanente do recurso-base e a desorganização da economia e cultura locais, uma vez que interfere nos modos de produção e comercialização praticados nas comunidades pesqueiras locais.

O conhecimento dos pescadores sobre o meio ambiente marinho é acumulado ao longo de uma vida de contato diário com este ambiente e transmitido ao longo de gerações. Este conhecimento vem sendo estudado por muitos pesquisadores, desde meados do século passado. Mussolini (1945), por exemplo, destacou o grau de detalhamento do conhecimento dos pescadores de Ilhabela sobre a pesca da tainha (*Mugil platanus*), que envolvia informações precisas sobre a chegada dos cardumes, a postura dos ovos, os movimentos destes peixes entre o ambiente marinho e

os estuários e sobre as condições ambientais (ventos, correntes) relacionados ao ciclo de vida desta espécie.

Estudos sobre o conhecimento ecológico local e sobre aspectos de Ecologia Humana dos pescadores do litoral paulista têm sido realizados nas últimas duas décadas em Cananéia, Iguape, Bertioga, Ilha de Búzios, Ilha da Vitória e Ubatuba, abordando a ecologia de peixes, técnicas de pesca, tabus alimentares, modelos de subsistência, territorialidade e uso de recursos naturais (Begossi e Richerson 1991, Begossi 1992, Begossi *et al*. 1993, Begossi 1995, Begossi e Figueiredo 1995, Begossi 1999, Hanazaki e Begossi 2000, Hanazaki *et al*. 2000, Begossi *et al*. 2001, Begossi *et al*. 2002, Begossi 2004, Begossi *et al.* 2004, Silvano e Begossi 2005, Begossi 2006a, Silvano *et al.* 2006).

Na medida em que a pesca artesanal começa a declinar como atividade econômica, fato este observado na área de estudo e percebido como uma tendência global (Pauly *et al.* 1998, Begossi 2006b), corre-se o risco do conhecimento dos pescadores, que é o cerne da cultura local, também desaparecer por ser gradativamente menos usado.

Os objetivos desta pesquisa foram realizar um levantamento da pesca artesanal na área de estudo em relação às artes de pesca praticadas, espécies-alvo da pesca local, tipos de embarcações utilizadas, ocorrências de interações entre a pesca e os cetáceos, bem como caracterizar o perfil sócio-econômico dos pescadores locais.

1.2 Materiais e Métodos

Neste estudo foram contempladas 14 comunidades de pesca ao longo do litoral de São Sebastião: Enseada, Cigarras, São Francisco, Pontal da Cruz, Barequeçaba, Toque-Toque Grande, Toque-Toque Pequeno, Paúba, Maresias, Boiçucanga, Barra do Sahy, Juqueí, Barra do Una e Boracéia. Algumas delas encontram-se em áreas centrais do município e, portanto, mais

urbanizadas, enquanto outras situam-se em praias mais preservadas, margeando as encostas da Serra do Mar (Figuras 1 e 2).

Figura 1. Barcos de pesca na praia de São Francisco, localizada na costa norte de São Sebastião.

Figura 2. Barcos de pesca da praia de Boiçucanga, apoitados próximo à barra do Ribeirão do Itú, na costa sul de São Sebastião.

A ausência de registros precisos sobre o número de pescadores artesanais ativos na área de estudo dificultou um pouco o cálculo do total de pescadores artesanais existentes em São Sebastião. Segundo registros da Colônia de Pesca local, mais de 1.000 pescadores estão cadastrados na categoria artesanal, porém o número exato dos que estão ativos foi difícil de obter, em função das estatísticas não estarem atualizadas.

Desta forma, selecionamos 70 pescadores das comunidades acima citadas, segundo sua maior experiência em relação à pesca artesanal. Foram incluídos no estudo os pescadores mais velhos do que 35 anos, residindo na área de estudo há mais de 10 anos, e praticando a pesca artesanal como sua principal ocupação há mais de 15 anos. O número de pescadores selecionados corresponde a cerca de 30% do total estimado de pescadores que se dedicam ativamente à pesca artesanal na região de estudo. Esta estimativa foi feita com base em observações de campo e nos dados obtidos pela autora em 2004, durante a execução do projeto "Estratégias de Conservação para a Toninha (*Pontoporia blainvillei*) nas Áreas de Manejo I e II: buscando alternativas para salvar uma espécie"[2], também conhecido como "Projeto Toninhas", que indicaram a existência de 235 pescadores artesanais ativos naquela ocasião.

O perfil sócio econômico dos entrevistados foi caracterizado através de entrevistas utilizando questionários com perguntas sobre: idade, local de origem, tempo de residência, tempo de dedicação à pesca artesanal, grau de escolaridade.

Com relação à caracterização das artes de pesca, utilizamos os dados obtidos durante a realização do "Projeto Toninhas", mencionado acima, por meio de questionários aplicados às comunidades estudadas com perguntas sobre tipo de embarcação e de apetrechos utilizados na pesca, locais de pesca e espécies-alvo. Nesta ocasião foram estrevistados pescadores nas mesmas

[2]Projeto realizado no litoral sudeste brasileiro, em 2004 e 2005, com os seguintes apoios: PROBIO/MMA/BIRD/GEF/CNPq. Um dos sub-produtos foi o levantamento das artes de pesca a nível local, que se pode examinar Tabela 1 deste capítulo.

comunidades abordadas neste estudo, sendo alguns deles os mesmos entrevistados na caracterização do perfil sócio-econômico dos pescadores locais.

1.3 Resultados

Os dados relativos ao perfil sócio-econômico dos entrevistados são apresentados nas figuras 3 a 6. Apenas uma representante do sexo feminino se encaixou nos critérios determinados para a seleção dos 70 pescadores entrevistados. A idade mínima dos entrevistados foi de 35 anos, a idade média igual a 59 anos e a idade máxima igual a 97 anos. A maioria (65%) dos entrevistados é nascida em São Sebastião (Figura 5) e 48% do total freqüentaram até os quatro primeiros anos do ensino fundamental (Figura 6).

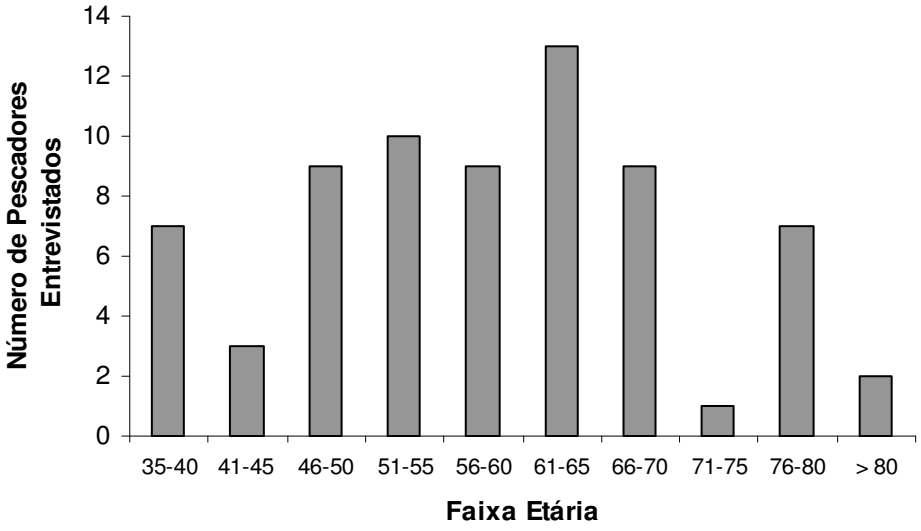

Figura 3. Número de pescadores entrevistados em cada faixa etária (n=70).

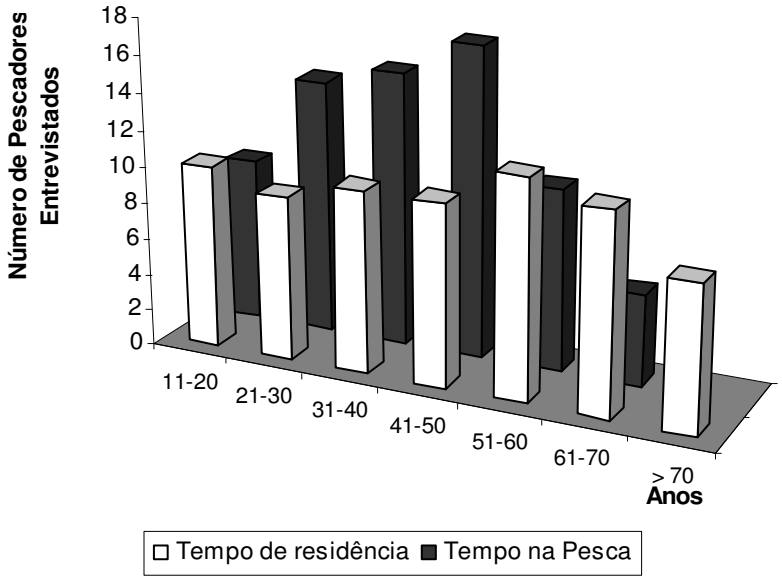

Figura 4. Número de pescadores de acordo com o tempo de residência na área de estudo e tempo de prática da pesca como principal atividade (n=70).

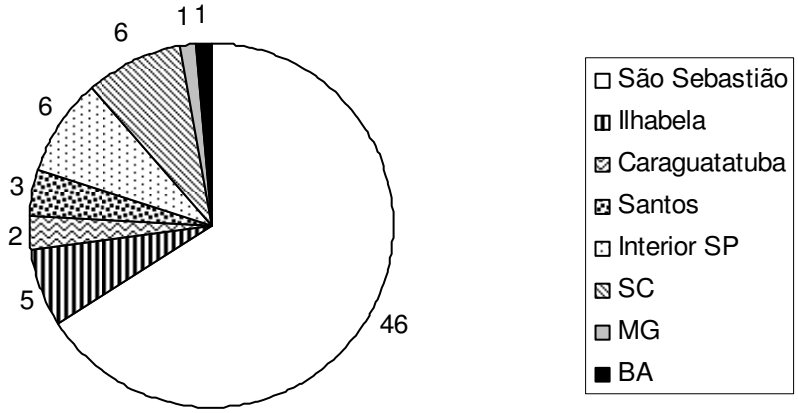

Figura 5. Número de pescadores segundo a cidade de origem dos entrevistados (n=70).

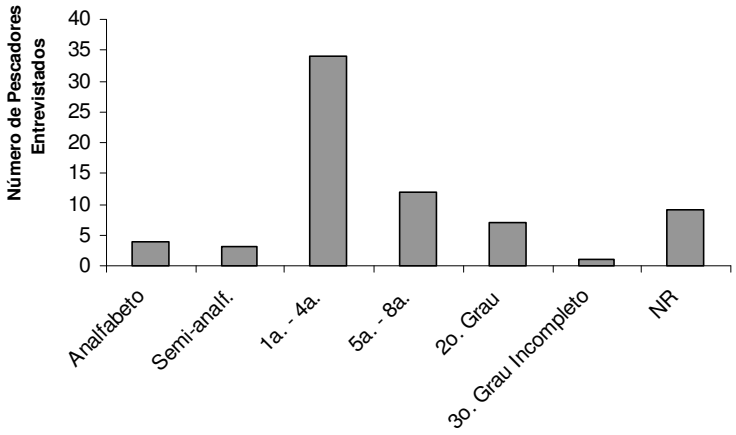

Figura 6. Nível de escolaridade dos 70 pescadores entrevistados (NR – não responderam).

As características da pesca praticada em cada uma das comunidades estudadas variaram, resultanto em certa diversidade no que se refere ao tipo de embarcação utilizada, que inclui canoas a remo, a vela e a motor, botes com motor de popa, baleeiras, lanchas e barcos de arrasto (Figura 7). Alguns pescadores utilizam mais de um tipo de embarcação, conforme o tipo de rede a ser utilizado ou as condições do tempo e do mar.

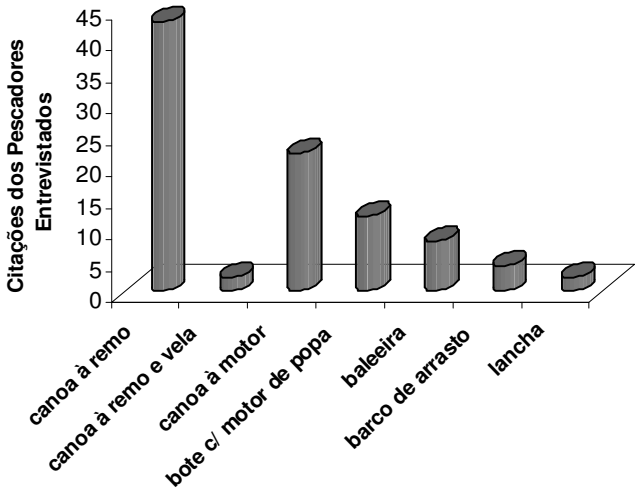

Figura 7. Tipos de embarcações utilizadas na pesca artesanal praticada em São Sebastião, conforme citações dos 70 pescadores entrevistados.

Os principais artefatos de pesca utilizados pelos entrevistados são: redes de pesca e linhas-de-mão. Dentre as redes, as mais mencionadas foram as redes de espera (de superfície, de fundo, de caceio, feiticeira e cerco flutuante) e as de arrasto rebocado (simples e duplo). Em relação às linhas-de-mão a mais citada foi a linha de fundo. Uma descrição dos tipos de artefatos de pesca mencionados e seus respectivos usos está incluída no Apêndice 1 deste capítulo. Um levantamento detalhado da pesca artesanal praticada em São Sebastião, no que se refere a artefatos e embarcações utilizados, espécies-alvo e principais pesqueiros, encontra-se na Tabela 1. Foram incluídos nesta tabela dados obtidos dos pescadores das praias de: Enseada, Cigarras, São Francisco, Pontal da Cruz, Barequeçaba, Toque-Toque Grande, Toque-Toque Pequeno, Paúba, Maresias, Boiçucanga, Barra do Sahy, Juqueí, Barra do Una e Boracéia. Vale ressaltar que este levantamento também foi realizado previamente a este projeto de Mestrado, no âmbito do "Projeto Toninhas" anteriormente citado. Na Tabela 2 apresentamos a identificação das espécies de peixes e crustáceos que são mencionadas na Tabela 1.

Tabela 1. Caracterização da pesca artesanal no município de São Sebastião, por meio de informações obtidas dos 70 pescadores entrevistados.

EMBARCAÇÕES envolvidas na pesca artesanal	Aproximadamente 150
PESCADORES ativamente envolvidos na pesca artesanal	Aproximadamente 230
TIPO DE ARTEFATO	**Rede de arrasto simples**
Nº embarcações	13
Comprimento das embarcações (m)	6 a 11 m
Capacidade de carga (t)	1 a 6 t
Potência do motor (hp)	22 a 127 hp
Autonomia de pesca (dias)	3 a 15 dias
Tempo de imersão do artefato por embarcação	4 a 5 arrastos de 1 a 2h por dia
	Diário: 4 a 8 h, Semanal: 20 a 40 h, Mensal: 80 a 160 h, Anual: 960 a 1920 h ou 40 a 80 dias
Esforço total de pesca anual (nº total embarcações x dias pesca/ano)	120 a 800

Nº de tripulantes	1 a 3
Espécies mais capturadas	Camarão sete-barbas (*Xiphopenaeus kroyeri*) e camarão-branco (*Litopenaeus schimitti*)*
Campo de pesca preferencial	De Ubatuba a Bertioga, especialmente na Enseada de Caraguatatuba e Canal de São Sebastião
Época de uso do artefato	Julho a Março (pesca suspensa durante o defeso – Abril a Junho).
Conservação do pescado	Gelo
Comercialização do pescado	Inteiro. Pode ser limpo depois de pesado e vendido.
Relação do artefato com cetáceos	Não há registro de interação.
TIPO DE ARTEFATO	**Rede de arrasto duplo**
Nº embarcações	15
Comprimento das embarcações (m)	8 a 12 m
Capacidade de carga (t)	2 a 8 t
Potência do motor (hp)	18 a 115 hp
Autonomia de pesca (dias)	3 a 5 dias
Tempo de imersão do artefato por embarcação	3 a 4 arrastos de 2 h por dia
	Diário: 6 a 8 h, Semanal: 30 a 40 h, Mensal: 120 a 160 h, Anual: 1440 a 1920 h ou 60 a 80 dias
Esforço total de pesca anual (nº total embarcações x dias pesca/ano)	900 a 1200
Nº de tripulantes	2 a 3
Espécies mais capturadas	Camarão sete-barbas e camarão-branco
Campo de pesca preferencial	De Ubatuba a Bertioga, até 15 milhas da costa, prof. 18 a 50 m.
Época de uso do artefato	Julho a Março (pesca suspensa durante o defeso – Abril a Junho).
Conservação do pescado	Gelo
Comercialização do pescado	Inteiro. Pode ser limpo depois de pesado e vendido.
Relação do artefato com cetáceos	Não há registro de interação.
TIPO DE ARTEFATO	**Rede de caceio de superfície (boiada)**
Nº embarcações	32
Comprimento das embarcações (m)	3,8 a 10 m
Capacidade de carga (t)	0,12 a 3 t
Potência do motor (hp)	4 a 25 hp e 13 canoas a remo
Autonomia de pesca (dias)	1 a 10 dias
Comprimento médio da frota de rede por embarcação (km)	0,8
Tempo de imersão do artefato por embarcação	Diário: 4 - 12 h, Semanal: 20 - 60 h, Mensal: 80 - 240 h,

	Anual: 960 - 2880 h ou 40 – 120 dias
Esforço total de pesca anual (Km total de rede x dias pesca/ano)	196 a 1680
Nº de tripulantes	1 a 4
Espécies mais capturadas	Tainha (*Mugil platanus*), parati (*Mugil curema*), enchova (*Pomatomus saltatrix*), sororoca (*Scomberomorus brasiliensis*), guaivira (*Oligoplites sp.*), prejereba (*Lobotes surinamensis*), dourado (*Coryphaena hippurus*), robalo (*Centropomus* sp.), pescada (*Cynoscion* sp.), oveva (*Larimus breviceps*), corvina (*Micropogonias furnieri*), garoupa (*Epinephelus marginatus*), cação (*Carcharhinus* sp.)
Campo de pesca preferencial	Enseada de Caraguatatuba, Ilha de Toque-Toque Grande à Alcatrazes, Ponta da Sepituba a Maresias, até a Ilha do Maracujá.
Época de uso do artefato	Janeiro a Dezembro.
Conservação do pescado	Gelo.
Comercialização do pescado	A maioria dos peixes são vendidos inteiros.
Relação do artefato com cetáceos	Captura acidental de toninhas e botos-cinza (*Pontoporia blainvillei* e *Sotalia guianensis*)
TIPO DE ARTEFATO	**Rede de espera de fundo**
Nº embarcações	58
Comprimento das embarcações (m)	3 a 10 m
Capacidade de carga (t)	0,2 a 2,8 t
Potência do motor (hp)	4 a 25 hp e 25 canoas a remo
Autonomia de pesca (dias)	1 a 3 dia
Comprimento médio da frota de rede por embarcação (km)	0,5
Tempo de imersão do artefato por embarcação	Diário: 1:30 - 24 h, Semanal: 7:30 - 120 h, Mensal: 30 -480 h, Anual: 360 - 5760 h ou 15 – 240 dias
Esforço total de pesca anual (Km total de rede x dias pesca/ano)	24 – 3840
Nº de tripulantes	1 a 4
Espécies mais capturadas	Tainha, parati, pescada, corvina, betara (*Menticirrhus* sp.), xaréu (*Caranx hippos*), pampo (*Trachinotus* sp.), carapau (*Caranx crysos*), guaivira, espada (*Trichiurus lepturus*), oveva, roncador (*Conodon nobilis*), linguado (*Paralichthys* sp.), robalo, enchova, sororoca, bonito (Scombridae), cação
Campo de pesca preferencial	Canal de São Sebastião, Enseada de Caraguatatuba, Ilha de Toque-Toque Grande à Alcatrazes, Ponta da Sepituba à Maresias, até a Ilha do Maracujá
Época de uso do artefato	Janeiro a Dezembro.
Conservação do pescado	Gelo.
Comercialização do pescado	A maioria dos peixes são vendidos inteiros.
Relação do artefato com cetáceos	Captura acidental de toninhas e botos-cinza (*P. blainvillei e S.*

	guianensis)
TIPO DE ARTEFATO	**Rede de espera de superfície**
Nº embarcações	55
Comprimento das embarcações (m)	3 a 8,5 m
Capacidade de carga (t)	0,3 a 1,2 t
Potência do motor (hp)	4 a 90 hp e 20 canoas a remo
Autonomia de pesca (dias)	1 a 3 dias
Comprimento médio da frota de rede por embarcação (km)	0,3
Tempo de imersão do artefato por embarcação	Diário: 4 a 24 h, Semanal: 20 a 120 h, Mensal: 80 a 480 h, Anual: 960 a 5760 h ou 40 a 240 dias
Esforço total de pesca anual (Km total de rede x dias pesca/ano)	240 a 720
Nº de tripulantes	1 a 3
Espécies mais capturadas	Tainha, parati, enchova, bonito, cavala (*Scomberomorus cavalla*), robalo, pescada, oveva, corvina, garoupa, badejo (*Mycteroperca* sp.), bagre (*Ariidae*), sororoca, cação
Campo de pesca preferencial	Canal de São Sebastião, Enseada de Caraguatatuba, Ilha de Toque-Toque Grande à Ilha do Maracujá, Ponta da Sepituba à Maresias.
Época de uso do artefato	Janeiro a Dezembro.
Conservação do pescado	Gelo.
Comercialização do pescado	Os peixes são vendidos inteiros.
Relação do artefato com cetáceos	Captura acidental de toninhas e botos-cinza (*P. blainvillei e S. guianensis*)
TIPO DE ARTEFATO	**Rede Bitana (Feiticeira)**
Nº embarcações	10
Comprimento das embarcações (m)	4 a 7 m
Capacidade de carga (t)	0,2 a 1 t
Potência do motor (hp)	1 a 9 hp e quatro a remo
Autonomia de pesca (dias)	1 a 5 dias
Comprimento médio da frota de rede por embarcação (km)	0,3
Tempo de imersão do artefato por embarcação	Diário: 4 h, Semanal: 20 h, Mensal: 80 h, Anual: 960 h ou 40 dias
Esforço total de pesca anual (Km total de rede x dias pesca/ano)	120
Nº de tripulantes	1 a 3
Espécies mais capturadas	Tainha, parati, corvina, pescada, betara, xaréu, pampo, espada, enchova, cação
Campo de pesca preferencial	Canal de São Sebastião, Enseada de Caraguatatuba,

Época de uso do artefato	Janeiro a Dezembro.
Conservação do pescado	Gelo.
Comercialização do pescado	Os peixes são vendidos inteiros.
Relação do artefato com cetáceos	Não há registro de interação.
TIPO DE ARTEFATO	**Cerco Fixo**
Nº embarcações	20
Comprimento das embarcações (m)	4a 8 m
Capacidade de carga (t)	0,2 a 1,5 t
Potência do motor (hp)	Remo e motor de 18 hp
Autonomia de pesca (dias)	1 dia
Comprimento médio da frota de rede por embarcação (km)	0,1 km
Tempo de imersão do artefato por embarcação	Diário: 24 horas, Semanal:120 horas, Mensal: 480 horas, Anual: 5.760 horas ou 240 dias.
Esforço total de pesca anual (nº total embarcações x dias pesca/ano)	480
Nº de tripulantes	2 a 4
Espécies mais capturadas	Enchova, tainha, galo (*Selene sp.*), carapau, guaivira, palombeta (*Chloroscombrus chrysurus*), espada, sardinha (*Sardinella brasiliensis*), parú (*Chaetodipterus faber*), sororoca, bonito, pirajica (*Kyphosus* sp.), cação,
Campo de pesca preferencial	Toque-Toque Pequeno e Grande, Paúba, Maresias.
Época de uso do artefato	Janeiro a Dezembro
Conservação do pescado	Gelo
Comercialização do pescado	*In natura* e inteiro
Relação do artefato com cetáceos	Não há registro de interação.
TIPO DE ARTEFATO	**Linha de fundo**
Nº embarcações	5
Comprimento das embarcações (m)	4-13 m.
Capacidade de carga (t)	1,2 - 7 t.
Potência do motor (hp)	7 - 60 hp e duas a remo.
Autonomia de pesca (dias)	1-7 dias.
Tempo de imersão do artefato por embarcação	Diário: 4 horas.
Nº de tripulantes	1 – 6
Espécies mais capturadas	Espada, porquinho (*Balistes capriscus*), corvina, betara, bagre, cação,
Campo de pesca preferencial	Canal de São Sebastião às Ilhas de Búzios e Vitória
Época de uso do artefato	Janeiro a Dezembro.
Conservação do pescado	Gelo.

Comercialização do pescado	*In natura* e inteiro.
Relação do artefato com cetáceos	Não há registro de interação.

* Identificação das espécies de peixes e crustáceos conforme Ávila-da-Silva (2005).

1.4 Discussão

Segundo o relato dos entrevistados em todas as comunidades estudadas, a pesca foi, até poucas décadas atrás, uma atividade econômica muito importante. Após a abertura da rodovia Rio-Santos no início da década de 1980, houve um aumento gradativo do aporte de turistas à região, fazendo com que as atividades comerciais e turísticas se desenvolvessem. Atualmente, com o declínio da pesca na área de estudo, esta atividade passou a ser uma ocupação a mais, dentre outras que se destinam a garantir a subsistência dos pescadores (Begossi 2006). Entretanto, apesar de não estarem mais sovrevivendo unicamente da pesca, a maioria dos pescadores entrevistados freqüenta diariamente os ranchos de pesca, mesmo nos dias em que não vão pescar, cuidando de seus equipamentos, cultivando o convívio social entre si e relembrando antigas estórias.

A dificuldade em obter o número total de pescadores artesanais ativos ocorre desde muito tempo. Mussolini (1945) menciona que durante o recenseamento de 1942, feito em Ilhabela pelo Ministério da Agricultura, o número de pescadores registrados em naquele município foi muito maior do que os que realmente estavam em atividade, sendo cerca de três vezes maior. Begossi (1999) estudando as interações entre pescadores, recursos e instituições, encontrou que pescadores caiçaras interagem menos com as instituições, se comparados aos caboclos da Amazônia, e sugere que isto pode ser resultante da informalidade em relação à organização social dos pescadores caiçaras.

As características da pesca praticada em cada uma das comunidades estudadas variaram em decorrência de características oceanográficas locais e do nível sócio-econômico do pescador. Houve também uma pequena variação a nível local e também relacionada à faixa etária do entrevistado, na

nomenclatura de algumas artes de pesca, entretanto, neste trabalho, utilizamos apenas os termos mais mencionados pelos pescadores. Esta variação pode ser resultado da introdução do vocabulário de pesca trazido por imigrantes, como os pescadores catarinenses que se instalaram no bairro São Francisco, em São Sebastião.

Algumas artes de pesca praticadas na área de estudo foram consideradas por vários pescadores como nocivas ao meio ambiente, como o arrasto de parelha, onde dois barcos navegam alinhados, arrastando entre si uma rede de arrasto de grandes dimensões, cujo impacto na fauna bentônica é catastrófico e já é sentido por pescadores da região. A rede feiticeira, ou bitana, embora utilizada por uma pequena parcela (n=3) dos entrevistados, também foi considerada um equipamento de alto impacto sobre os estoques de peixes. A ocorrência de capturas acidentais de tartarugas e botos também foi mencionada por alguns pescadores, sendo que alguns relacionaram a maior freqüência destes acidentes com a crescente população destas espécies, uma vez que sua caça é proibida por lei. Alguns entrevistados mostraram seu descontentamento em relação a várias normas que regulamentam a pesca, afirmando que muitas delas não se ajustam adequadamente à realidade dos estoques pesqueiros da região, sendo, portanto ineficazes quanto à preservação destes estoques. Um dos exemplos mais mencionados por todos foi o defeso do camarão, cujo período, segundo alguns dos entrevistados, encontra-se defasado em relação ao ciclo de vida dos camarões desta região. Entretanto, apesar de uma grande parcela dos pescadores entrevistados formular as mesmas queixas, eles mostraram-se um pouco descrentes de que estas normas venham a ser reformuladas ou mesmo que a situação da pesca melhore a curto prazo.

Há duas décadas atrás, Acheson (1981) discutiu o conflito gerado entre os diversos setores da pesca devido às regulamentações pesqueiras, dificultando o sucesso dos planos de manejo pesqueiros americanos. Este autor enfatizou que enquanto não conseguirmos implantar sistemas de manejo pesqueiros que visem a sustentabilidade biológica, social e econômica, a sobre-explotação

dos recursos pesqueiros continuará causando o declínio da pesca como atividade econômica, ameaçando a existência das próprias comunidades pesqueiras.

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Apêndice 1

Caracterização dos apetrechos de pesca mais comumente utilizados em São Sebastião[3].

1. Redes de Arrasto

A rede de arrasto de fundo é um artefato de forma cônica, composto por asas, corpo e ensacador. Pranchas de madeira, denominadas portas, pesando cerca de 12 kg cada são presas às asas laterais para estabillizar o arrasto durante o deslocamento da embarcação, revolver o substrato e direcionar o pescado ao interior da rede (Figura 1). O comprimento da rede varia de 8 a10 m, com a boca medindo cerca de 6 m. A malha da rede no corpo e no ensacador mede, respectivamente, 4 e 3 cm. Esta rede é confeccionada com linha de polipropileno, de 1 mm de espessura no corpo da mesma e 2 mm no ensacador.

Nomalmente, a pesca de arrasto é praticada durante a madrugada e início da manhã, podendo se estender por um período de até 24 horas consecutivas.

2. Redes de espera

As redes de espera apresentam formato retangular e são posicionadas verticalmente no mar. Apesar de apresentarem inúmeras variações, as redes são geralmente compostas por uma série linear de panos medindo de 60 a 100 m de comprimento cada, com flutuadores de 4-8 cm de diâmetro fixados na corda superior e pesos com 50-200 g cada na corda inferior. A presença de garatéias ou âncoras e bandeiras são observadas em algumas modalidades de redes de espera. As bóias e os pesos mantêm a rede esticada dentro d'água, as garatéias ou âncoras a mantêm fixa na posição original e as bandeiras marcam o local onde a rede foi estendida.

[3] Conforme dados obtidos no levantamento realizado pelo projeto "Estratégias de Conservação para a Toninha (*Pontoporia blainvillei*) nas Áreas de Manejo I e II: buscando alternativas para salvar uma espécie" (PROBIO/MMA/BIRD/GEF/CNPq).

As redes de espera podem ser posicionadas próximo à superfície ou ao fundo e as variações entre as diversas modalidades incluem diferenças no comprimento total, altura, tamanho de malha, natureza e espessura do material usado na confecção, modo de operação e espécies-alvo.

2.1 Rede de espera de fundo (ou de caçoá):

A rede de espera de fundo é disposta próximo ao fundo e se mantém fixa ao substrato por meio de âncoras que se prendem às suas extremidades. Bóias de isopor ou plástico indicam a localização da rede (Figura 2a).

Esta rede pode permanecer na água ao longo da semana, sendo inspecionada diariamente, no início da manhã; ou pode ser colocada no mar ao final da tarde e recolhida na manhã seguinte. Esta prática é geralmente conduzida por meio de canoas a remo.

2.2 Rede de espera de superfície:

A rede de espera de superfície é disposta próxima à superfície e o seu modo de operação é semelhante a rede de caceio, com a diferença que fica fixa. Bandeiras de plástico de cor escura são colocadas ao longo da rede ou nas suas extremidade para fins de localização, a uma altura de cerca de 3 m da linha d'água (Figura 2b). A rede é lançada ao mar no final da tarde e recolhida na manhã seguinte, e cada operação de pesca dura de 1-2 dias.

2.3 Rede de caceio (ou caída):

A rede de caceio pode ser disposta próximo à superfície ou ao fundo. O seu posicionamento varia conforme o substrato, condições ambientais e espécies-alvo (Figura 2c). Sua principal característica é o seu deslocamento durante a operação, mantendo uma das extremidades presa à

popa do barco e a outra derivando em função das correntes marinhas. A rede é lançada numa determinada área e as correntes promovem seu deslocamento, sendo depois recolhida.

Bandeiras de plástico de cor escura e/ou sinalizadores luminosos à bateria são colocadas ao longo da rede ou apenas na sua extremidade para fins de localização, a uma altura de cerca de 3 m da linha d'água. Bóias de isopor ou plástico ou pedras são dispostas na corda superior ou inferior, respectivamente, de acordo com o posicionamento da rede na coluna d'água. O modo de operação mais comum se refere ao lançamento da rede no final da tarde e recolhimento na manhã seguinte, com cada operação de pesca durando de 4-5 dias.

3. Linha de fundo:

A linha de fundo é formada pela linha principal, com um anzol fixado na extremidade. O comprimento e a espessura do nylon e o tamanho do anzol são variáveis. De um a três prumos pesando cerca de 1 kg cada um, são fixados na porção terminal da linha, mantendo-a próximo ao fundo. O tipo de isca utilizado nessa pescaria varia entre musculatura de peixes e iscas artificiais.

As linhas de fundo operam durante o dia e à noite, de acordo com a disponibilidade das espécies-alvo, e o seu comprimento varia em função da profundidade no local de pesca.

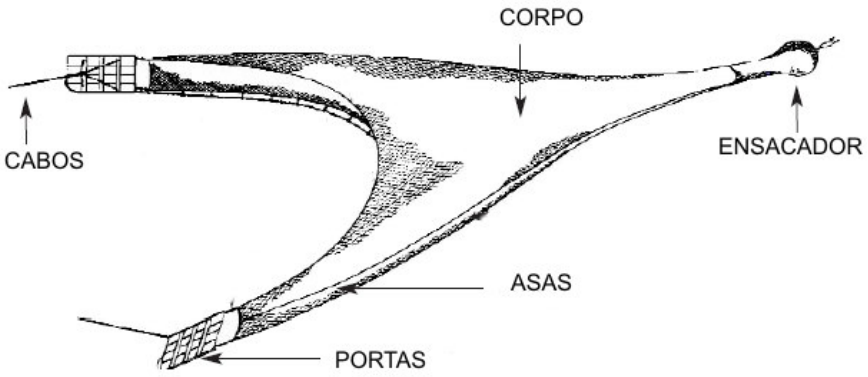

Figura 8. Rede de arrasto. Duas 'portas' laterais (painéis de madeira) mantém a 'boca' da rede aberta, enquanto a mesma é arrastada pelo fundo do mar, concentrando os organismos marinhos no 'ensacador' ao fundo da rede. (Ilustração retirada e modificada da publicação "Squandering the seas", relatório de 2003 da Environmental Justice Foundation)

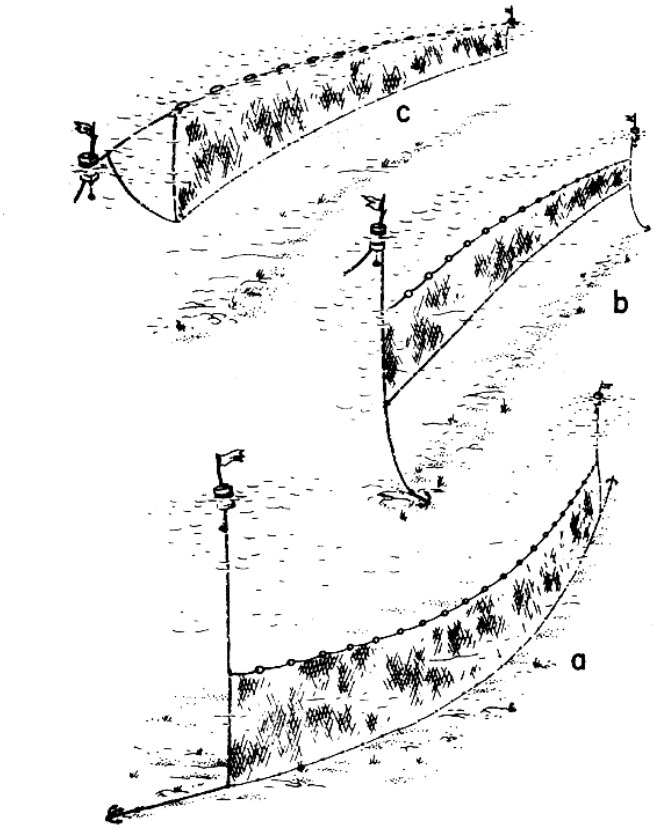

Figura 9. a – Rede de fundo, b – rede de superfície, c – rede de caceio. (Ilustrações: S. Maugeri, retiradas do manual: FAO Training Series – Fishing with bottom gillnets)

Capítulo 2

WHALES, DOLPHINS OR FISHES? THE ETHNOTAXONOMY OF CETACEANS IN SÃO SEBASTIÃO, BRAZIL

Golfinhos-pintados-do-Atlântico (*Stenella frontalis)* próximo a Ilha Vitória, litoral paulista.

Whales, dolphins or fishes? The ethnotaxonomy of cetaceans in São Sebastião, Brazil

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Abstract

The local knowledge of human populations about the natural world has been addressed through ethnobiological studies, especially concerning resources uses and their management. Several criteria, such as morphology, ecology, behavior, utility and salience, have been used by local communities to classify plants and animals. Studies regarding fishers' knowledge on cetaceans in the world, especially in Brazil, began in the last decade. Our objective is to investigate the folk classification by fishers concerning cetaceans, and the contribution of fishers' local knowledge to the conservation of that group. In particular, we aim to record fishers' knowledge in relation to cetaceans, with emphasis on folk taxonomy. The studied area is São Sebastião, located in the southeastern coast of Brazil, where 70 fishers from 14 communities were selected according to their fishing experience and interviewed through questionnaires about classification, nomenclature and ecological aspects of local cetaceans' species. Our results indicated that most fishers classified cetaceans as belonging to the life-form 'fish'. Fishers' citations for the nomenclature of the 11 biological species (10 biological genera), resulted in 14 folk species (3 generic names). Fishers' taxonomy was influenced mostly by the phenotypic and cultural salience of the studied cetaceans. Cultural transmission, vertical and horizontal, was intimately linked to fishers' classification process. The most salient species, therefore well recognized and named, were those most often caught by gillnets, in addition to the biggest ones and those most exposed by media, through TV programs, which were watched and mentioned by fishers. Our results showed that fishers' ecological knowledge could be a valuable contribution to cetaceans' conservation, helping to determine areas and periods for their protection, indicating priority topics for research and participating in alternative management related to the gillnet fisheries.

Introduction

Natural science comprehends the observation and study of the ways in which nature works. Consequently, scientists have gathered an empirical knowledge of the physical and biological world in order to provide a better understanding of the universe. Anthropologists and biologists have been studying 'local' or traditional knowledge accumulated for generations by several communities around the world [1]. The local knowledge about the natural world is the object of study of Ethnobiology, which studies the interactions between human population and natural resources, with special concern to human perception, knowledge and resource uses and management [2]. Human societies depend on natural resources and in this process humans began classifying plants and animals, originating diverse folk taxonomies [3]. The importance of the cognitive process – recognition, categorization and identification - was suggested by several authors [4, 5] and Simpson [6] synthesized this point of view in his famous declaration: *"classification… is an absolute and minimal requirement of being or staying alive"*. Berlin [3] reinforces this view when he affirms that the human ability to recognize and categorize animals and plants is probably innate as we have an unconscious perception of the biological reality. Mishler and Donoghue [7] also argument that human brains are linked to the same neural process of "grouping by perception".

The reality of biological species has been discussed since Lamarck and Lyell in the 18th century [8] and Darwin [9] in "The Origin of Species" questions about the reality of species when he points out that the term species is arbitrary. Nevertheless, in unpublished notes from 1871, Darwin accepted the idea of biological discontinuities. Such discrete groups among plants and animals were considered by Dobzhansky as universal, a fundamental characteristic of biological diversity [10].

Several criteria, such as morphology, ecology, behavior, utility and salience ('biological distinctiveness'), have been used by local communities to classify plants and animals [3, 11, 12]. The process of classifying and giving names to plants and animals was extensively studied by Berlin

[3] who defines general principles to ethnobiological categorization and nomenclature. Hunn [13] suggests that cultural knowledge must be useful, or adaptive, considering the amount of energy invested in obtaining it. According to this author *'human perception is programmed to recognize patterns among living organisms'* [13].

Local ecological knowledge (LEK), also known as traditional ecological knowledge (TEK), has been studied in several parts of the world, not only with the purpose of retrieving or bringing value to vanishing cultures but as a useful tool to improve natural resources' conservation and management policies [14-17]. Furthermore, LEK involves not only ecological knowledge accumulated and community's beliefs, but also its social systems of rules necessary to manage local resources, which are transmitted through generations by culture [18].

Besides other traditional or 'local' communities, fishers' groups have been studied in several countries around the world, especially in relation to their knowledge about plant's utilization, fish ecology and fisheries management [11, 14, 15, 17, 19-30].

Studies regarding fishers' knowledge about cetaceans in the world, with special reference to Brazil, began in the last decade [31-36] and are mostly related to the ecological aspects. The frequent occurrence of whales and dolphins in the northern coast of São Paulo State (Ubatuba, Caraguatatuba, São Sebastião and Ilhabela municipalities) has been confirmed along the last 12 years, through records of sightings and stranded or incidentally captured animals. According to reports of the *'Projeto SOS Mamíferos Marinhos',* from September 1994 to September 2006, 138 cetaceans of 16 species (*Megaptera novaeangliae, Balaenoptera edeni, B. acutorostrata, Eubalaena australis, Pontoporia blainvillei, Sotalia guianensis, Stenella frontalis, Tursiops truncatus, Steno bredanensis, Delphinus capensis, D. delphis, Kogia sima, Pseudorca crassidens, Orcinus orca, Berardius arnouxii and Mesoplodon mirus*) have been recorded dead or alive, in the studied area (S.S. unpublished data 2006).

Artisanal fisheries are one of the main commercial activities practiced by local communities, called '*caiçara*', living in coastal sites of the Atlantic Forest, in Brazil. In previous surveys carried out by *'Projeto SOS Mamíferos Marinhos'* one of the authors (S.S.) recorded the interactions between fishers and cetaceans, especially in relation to species of coastal dolphins which occur at the main fishing points used by fishers and that are occasionally caught by gillnets. Two of these species, *Pontoporia blainvillei* and *Sotalia guianensis* are the most impacted by incidental catch and the former one is considered vulnerable, according to IUCN and IBAMA red lists [37, 38]. The International Whaling Commission (IWC) has recognized, in 1972, the accidental capture of cetaceans as a threat to populational stocks of small cetaceans, especially from the families Phocoenidae, Pontoporiidae and Delphinidae [39].

Our objective, in this study, is to record the fishers' knowledge in relation to cetaceans, with special emphasis on folk taxonomy (ethnotaxonomy), analyzing fishers' forms of classification and nomenclature of whales and dolphins in the Southeastern Brazilian coast. We expect to find a detailed nomenclature among fishers, especially related to dolphins' species, since these animals are frequently observed by fishers at sea and some of them are incidentally captured along coastal beaches.

Materials and Methods

Studied Area

The northern coast of São Paulo State is 161km long and it is composed by 164 beaches and 17 islands. It encompasses the districts of Ubatuba, Caraguatatuba, São Sebastião and Ilhabela (Figure 1). Currently, tourism is the most important commercial activity in the region as a whole. The district of São Sebastião (23º42'18" to 23º45'38"S – 45º25'41" to 45º53'49"W) is composed by a narrow plain area located between the sea (Atlantic Ocean) and the slopes of Atlantic Forest

and is inhabited by nearly 70.000 people [40]. Its coast line is 80 km long and is composed by 34 beaches. The biggest oil terminal (TEBAR – TRANSPETRO) of Latin America is located in the town and is the main source of income to the city of São Sebastião, followed by tourism and fisheries.

Fisheries activities

Most of the fishers in São Sebastião, as well as from other sites of the northern coast of the São Paulo State, practice artisanal coastal fisheries, using paddled canoes or motored boats measuring from 5 to 15 meters. Trawling nets, several kinds of gillnets and hook and line are the main equipment used in the local fisheries (Figure 2). Artisanal fishing is practiced by nearly 250 members of communities around the coast of S. Sebastião, but according to elders, the involvement of local people in such activity has been decreasing over the years. One of the reasons for that could be the reduced monetary incomes earned from fishing activities year by year as a result of a probable fish stock depletion, among other causes.

Methodology

Fishers resident in 14 communities along São Sebastião coast were selected according to criteria related to local fishing experience: age more than 35 years, living in the studied area for more than 10 years and fishing, as main activity, for more than 15 years. A total of 70 fishers were selected. Some of them had participated in previous interviews about the interaction cetacean versus fisheries and were known by their confirmed experience in fisheries. Others were indicated by these ones through the 'snow-ball' method, used in other studies [41, 42]. When asked about his accordance in participating of the interviews, each selected fisher gave his consent. The communities chosen were: Enseada, Cigarras, São Francisco, Pontal da Cruz, Barequeçaba, Toque-Toque Grande, Toque-Toque Pequeno, Paúba, Maresias, Boiçucanga, Barra do Sahy, Juqueí, Barra do Una and Boracéia (Figure 1). The interviews were carried out from January 2005 to July 2006.

Using partially structured questionnaires, as well as unlabelled figures and photos of 11 cetaceans' species which occur in the studied area, we interviewed each fisher individually, asking questions about cetaceans' names, classification and the form by which they could be grouped. Cetaceans' species included in this survey were: Family Balaenidae: *Eubalaena australis,* Family Balaenopteridae: *Megaptera novaeangliae, Balaenoptera edeni* and *B. acutorostrata* from the suborder Mysticeti and from the suborder Odontoceti*,* Family Delphinidae: *Orcinus orca, Tursiops truncatus, Steno bredanensis, Stenella frontalis, Delphinus* sp.*, Sotalia guianensis* and Family Pontoporiidae: *Pontoporia blainvillei.* The distribution of these species along São Sebastião coast is heterogeneous, some of them occurring at the northern coast, others occurring at the southern coast and some have been recorded at the entire coast [43-46].

In previous researches on cetaceans at the studied area along the last 12 years, we had perceived that a significant number of local fishers referred to whales and dolphins as 'fishes'. In face of this trend, we decided to ask two direct questions related to cetaceans' classification ('*Are whales and dolphins fish*?' and *'If yes / no, why?'*), in order to quantify the proportion of fishers who considered (or not) cetaceans as fishes and to find out what other classification groups that they could eventually mention.

In order to obtain the names used by the local fishers regarding to the studied cetaceans, we asked the questions *'Do you know this animal?'* and *'How do you call it?'*

All fishers were interviewed when working or staying at their '*ranchos*', places where they keep their fishing equipments and where they can be found before or after going to sea. Interviews had an average duration of 45 minutes. After fishers' consent, we took photos of their equipments, boats and activities during the interviews, in order to illustrate the local fisheries.

Data analysis

The answers given by the fishers were recorded as ´citations´, being possible to obtain more than one citation per answer relative to each question. Therefore, for some questions the number of citations was different from the number of interviewed fishers. In order to standardize the results, we show the data as the total number of citations for each question, followed by its correspondent percentage value when necessary. We included all the citations, not only those most mentioned by fishers, to avoid loosing rare or uncommon names but statistical analyses did not consider citations with very low frequencies (5 or below).

Cetaceans' species identification and its English common names followed [47]. We adopted Berlin's ethnobiological classification, which recognizes 6 hierarquical groupings (*taxa*) of greater and lesser inclusiveness called *kingdom, life-form, intermediate, generic, specific* and *varietal* [3]. In this study we compared scientific ranks (suborders Mysticeti and Odontoceti and species) to folk ranks (generic and specific) and identified possible correspondences among Linnaean and folk categories. The types of correspondence between scientific and folk taxonomies followed Berlin [48].

Concerning classification of cetaceans we tested citations obtained for the different categories using Chi-square to see if there is any difference between whales and dolphins' classifications. However, we analyzed citations related to killer whales (*Orcinus orca)* into the group 'whales', because despite being an Odontoceti from the Family Delphinidae, represented mostly by dolphins and porpoises, *O. orca* is considered a whale by many cultures around the world, due to its bigger size in relation to other dolphins. Nevertheless in relation to nomenclature we analyzed killer whales apart, due to the external factors that influence its nomenclature, not including this species in the statistical analyses performed.

We tested nomenclature's citations for two geographic areas – northern and southern coast of São Sebastião - according to the localization of the studied fishing communities, through Chi-square test, in order to verify possible patterns of distribution among cetaceans' species along the coast.

The frequency of citations for the 6 most quoted species and the frequency of records (related to incidentally caught or stranded individuals in the studied area, data gathered from a 12 years' research by 'Projeto SOS Mamíferos Marinhos') were compared using Chi-square test, in order to see if species are cited in the same proportion in which they are captured or appear dead on the beaches. All statistical tests were performed using the software BioEstat 4.

Results

Among the interviewees, 46 (66%) are native from São Sebastião, 10 (14%) are from neighboring municipalities such as Caraguatatuba, Ilhabela and Santos, and 14 (20%) are from inland cities of São Paulo or from other states. There was just one woman among the 70 fishers interviewed. Ages varied from 35 to 97 years, average age being 59 years old. The average period dedicated to fisheries, among all the interviewees, was about 40 years. The minimum time of residence in São Sebastião was 13 years and the maximum was 97 years. Regarding to time attending a school, 4 (6%) never went to school, 37 (53%) attended primary school but only 19 finished it, 31 (44%) started secondary school but only 4 finished it, 7 (10%) completed high-school, 1 started college but did not finish it and 9 (13%) did not know how to answer this question.

Classification

Regarding to the questions about cetaceans' classification, some fishers did split their answers related to whales or dolphins, others answered by grouping whales and dolphins together. We separated the answers relative to whales and dolphins in order to better understand the variations in the number of citations relative to each mentioned category.

In relation to whales, in 26 citations (37%) fishers considered them as fish. The other citations consider whales as mammals (28%) and as 'non-fish' (20%), but did not define them as mammals (Figure 3). Regarding dolphins' classification, according to fishers' answers, almost half of the citations (31 or 44%) mentioned that dolphins are fish, while 21% considered them as mammals and another 18% affirmed that they are not fish (Figure 3). Statistically, there was no difference among the answers referent to the three life-form categories ('fish', 'mammal', 'not-fish') for whales or dolphins (χ^2=1.18, d.f.=2, p=0.55) (Table 1).

It was interesting to note that for the three categories ('fish', 'mammal', 'not fish') mentioned above, we found the subcategory "*look like sharks / are from the sharks' family"* as an additional answer, represented by 8 citations for whales as well as for dolphins. Two fishers considered whales and dolphins as a mixed category called 'fish-mammals' and three fishers did not know how to classify these animals.

Nomenclature

From fishers' answers related to nomenclature we obtained 3 generic names and 14 folk species, 9 of them corresponding to binomials (Figure 4). Most of these binomials were composed by a describer related to the animal's coloration pattern (Table 2). We also verified two types of correspondence between scientific and folk systems of classification (Table 2). The first was 'Over-differentiation type I', when two or more folk taxa refer to a single biological species, as in the case of the folk species 'jibarte' and 'jubarte' referring to *Megaptera novaeangliae*, 'orca' and 'baleia orca' referring to *Orcinus orca* and 'boto-rajado', 'boto-malhado' and 'golfinho-malhado' referring to *Stenella frontalis* and its spotted coloration pattern (Figure 5). The second type of correspondence was 'Under-differentiation type II', when a single folk genera refers to two or more species of two or more genera, as in the case of 'baleia', quoted for 3 species of whale (order Mysticeti) and *for O. orca* (order Odontoceti), 'baleia-branca' mentioned to *B. edeni* and for *O. orca*, 'boto' quoted for 7

species of dolphins (order Odontoceti), 'golfinho' mentioned for 6 species of dolphins, and folk species 'toninha' cited for 3 species of dolphins and 'boto-caldeirão' quoted for 2 species of dolphin.

Concerning to whales, including *O. orca*, the folk name most cited was 'baleia', with 85 citations (98% of the generic names mentioned for whales), followed by folk species 'orca' (27 citations) and 'jibarte' (15 citations) (Table 2).

In relation to *O. orca*, many fishers who knew its name said to have learnt it from TV programs. Although it's not a common species in the studied area, 45 fishers (64%) cited 2 generic names ('baleia' and 'boto') and 3 binomials ('orca', 'baleia-orca' and 'baleia-branca') referring to killer whales and among them only 12 have seen this animal at sea (Table 2). The other 33 interviewees have only seen it on TV.

In the case of dolphins' species, the generic name most quoted was 'boto', with 165 citations (59% of the generic names quoted for dolphins), followed by folk species 'toninha' (61 citations) and generic name 'golfinho' (41 citations) (Table 2).

From the 10 cetaceans species occurring at the coast of São Sebastião, excluding *Orcinus orca*, which was analyzed apart in relation to nomenclature, 9 species were cited by fishers from the northern coast and 10 by those from the southern coast. Nevertheless, when compared through Chi-square test, data showed no differences between the frequency citations for each species between these two areas (χ^2=4.17, d.f.=8, p=0.84) (Table 3).

The frequency of citations for *M. novaeangliae, T. truncatus, S. bredanensis, S. frontalis, S. guianensis* and *P. blainvillei* were compared to the frequency of records for those species through Chi-square Tests, which showed that numbers of species' citations are very different to those of species' records in the studied area indicating that there is no proportionality between citations and occurrences of incidental capture or stranding of cetaceans (Table 4).

Clustering the studied species by similarity

Eighteen clusters (or groups) of the studied species were formed by 63% of the interviewed fishers, based mainly in morphological similarity among species. The most cited one was the group composed by *Tursiops truncatus* and *Sotalia guianensis*, which was cited by 23 fishers (27%). These two species were also present in groups formed by 3 species, mentioned in other 9 citations. Another 32 fishers (37%) answered that it was not possible to group any species, because each one was unique and different from the others (Figure 6).

Discussion

Folk taxonomy is a form of organizing local communities' knowledge and it may represent different behavioral responses of people related to the salience of each organism [49]. Concerning the interviewed fishers, despite their level of formal education, their long-life accumulated knowledge on marine environment seems to be sophisticated, at least considering local fish species, to which they show knowledge comparable to other studied communities in the southeastern Brazilian coast [10, 16, 21, 22]. On the other hand, cetaceans' folk taxonomy built by fishers living at São Sebastião seems to be a small inventory. The ethnobiological classification of local communities in general is usually based on the salience of the organisms in the local habitat and on the observed morphological and behavioral similarities and differences among the recognized groups [3]. The criteria utilized in cetaceans' classification by the studied fishers are probably related to cognitive aspects. As whales and dolphins are not targets to the fisheries practiced in studied areas, utility may not be the main criterion adopted by fishers in classifying these animals. However whales and dolphins' presence is very salient to be unnoticed, due to their size and behavior.

According to Dougherty [50] the salience of a biological group of organisms results from the degree of direct interaction between people and these organisms. Thus, ethnotaxonomy also reflects the availability of living organisms in the environment [10]. Salience can be cultural as well as perceptual or phenotypic [12] and generally the most salient organisms are named through primary lexemes [51]. This author pointed out that people's vocabulary is related to their long-term interests and the subsistence mode is the main factor determining the size of a folk taxonomy. When societies shift from a non-cultivator (as hunting-gathering ones) to cultivator mode of subsistence, their taxonomies tend to increase as they will be in contact with a new variety of introduced domesticated species, which will be added to the local organisms normally collected or hunted, what promotes the increasing of binomially named species [51, 52]. Regarding to their subsistence mode, fishing communities from São Sebastião could be classified as small-scale cultivation societies, whose taxonomies are characterized by bigger inventories with more binomials if compared to the taxonomies of hunting/gathering societies, which have smaller inventories of highly salient organisms.

The results of interviews showed that whales and dolphins were classified by most fishers into the category 'fish', but with little difference for the other categories ('Mammals' and 'Not fish') (Figure 3). The category 'fish' represents a life-form, which corresponds to a high-ranking folk taxonomic category, following Berlin [3]. Previous researches in ethnotaxonomy have suggested that life-forms may be not always 'natural' groupings [3], being sometimes arbitrary. In spite of being highly salient animals, mammals are not classified into a single life-form in several folk taxonomies [3, 53]. Cetaceans, classified as mammals by Linnaean taxonomy, are in fact members of life-form 'fish' in several folk taxonomies, such as those of fishers from Hong Kong, Solomon Islands, Brazilian Northeastern and Southeastern coasts [19, 23, 24, 32]. The life-form 'fish' is characterized by different groups of animals that live in aquatic habitats, including fishes, aquatic

invertebrates, turtles, crocodiles, dugongs, whales and dolphins [13,18,19,32]. Paz and Begossi [54] studying the folk taxonomy of fishes at Gamboa, (Sepetiba Bay, Southeastern Brazilian coast) also found that local dolphins are classified as an ethnospecies ('boto') belonging to the ethnofamily 'Cação' (sharks).

Analyzing the life-form 'fish', Hunn [13] considered that it is defined not in terms of morphological similarity as other life-forms, but rather in terms of habitat. Our results agree with his analysis as the main reason mentioned by fishers to classify cetaceans as fish was *'because they live in the sea'* (n=15). Nevertheless, fishers have the perception that whales and dolphins are *'a different kind of fish'*, and the differences most cited were their behavior and the quality of their flesh. In two citations, fishers suggested that these animals are in fact *'fish-mammals'*, an idea suggested before by Dupré [55], who discussed the scientific pluralism in biological classification. This author suggests that there are many forms of classification, most of them being arbitrary and overlapping. Life-form 'mammal', the second most quoted by fishers (n= 35) was justified by them in terms of behavioral aspects of cetaceans: *'they are mammals because the mothers breast-feed their calves'*, emphasizing the maternal care. This life-form is also considered 'artificial' or arbitrary by Atran [53], because the wide variation of features presented by their representatives' groups makes it difficult for a non-biologist to form a perceptual reference of the life-form 'mammal'.

The concept of cetaceans belonging to the life-form 'fish' is more than a question of perception; it is also part of the process of cultural transmission through generations of studied fishers. This became evident when some fishers mentioned that despite having watched on TV programs the information that cetaceans are in fact mammals, they continue referring to whales and dolphins as fishes because they have learned it from the elders. Cultural transmission from modern societies to local communities was detected too. According to 47% of the interviewed fishers they have learnt about killer whales (*Orcinus orca*) regarding to nomenclature, appearance and behavior

watching TV programs, despite have never seen this cetacean in nature before. Independently of the cetacean being classified as 'fish', 'mammal' or just 'not fish', the link between cetaceans (especially dolphins) and sharks was mentioned by eight fishers. The main reason for this association, according to the interviewees, is the morphological similarity between the two groups, especially in relation to the dorsal fin and flippers, texture and color of skin. Their resemblance can be explained by convergent evolution, where different species subjected to similar selective pressures develop similar traits and in their case resulted in adaptation to live in aquatic environments [56]. Both groups occupy the top of the marine trophic web, which contributes to their high natural salience. The perception of the similarity between sharks and cetaceans by the fishers reinforces the inclusion of whales and dolphins in the life-form 'fish'.

When comparing citations with records (stranding and incidental capture) of the six most frequent species (Table 4), we expected that species which occur more frequently would be more recognized and named [57]. In general, this trend was confirmed, but values found for each species' citations were not proportional to the numbers of each species records. This can be explained since not all the species show the same salience, especially if we consider that the probability to be captured in gillnets is greater for the smaller dolphin species [58, 59]. Additionally, it is virtually impossible to record all the individuals that die along the year in the area, because only part of the carcasses arrives to inhabited points of the coast. Among dolphins, two of the most cited species (*P. blainvillei* and *S. guianensis*) are the most locally caught by gillnets [44], which increases their salience to the fishers. Concerning whales, in spite of showing seasonal occurrence, lower records of stranding and not being so frequently affected by gillnets as dolphins, they are almost as salient as dolphins, considering fishers' citations.

Our results indicated that fishers from São Sebastião perceive cetaceans primarily as composed of three wider groups, the folk genera 'baleias' (whales), 'botos' and 'golfinhos' (the last

two genera referring to dolphins), which are intimately linked by an overall morphological similarity. These folk names were the most readily recognized by fishers, when considering the taxon Cetacea, and included several folk species, some of them binomially named (Figure 4), which agrees with the ethnobiological categorizarion proposed by Berlin [3]. However, this author observed that nearly 80 % of folk genera in typical folk taxonomies are monotypic, including no subgeneric taxa [3]. This observation did not apply to our data, since the 3 folk genera are not monotypic.

Whales were named by the interviewed fishers mostly by the folk genera 'baleia', which could reflect its low salience as species. A possible explanation could be its rarer presence along the year, showing peaks of occurrence during the winter [45], when fisheries is more affected by the bad weather, decreasing the oportunity of encounters between whales and fishers. Specific names were mentioned by fishers especially for the two species most exposed by TV programs (humpback and killer whales), denoting external influences on the fishers' perception in the studied region. Humpback and killer whales are between the most studied cetaceans' species in the world [37, 38] and TV documentaries about them are frequently showed in the most watched Brazilian TV Channel (Globo TV). Killer whale (*O. orca*), despite being an Odontoceti, was included by fishers in the generic tank 'baleia' (which includes all the Mysticeti). It is a large animal, comparable to the smaller species of whales. Hunn [57] pointed out that size is an important characteristic directly related to perceptual salience, increasing the chances of an organism to be recognized. In fact, for fishers from São Sebastião, *O.* orca figured at the boundary between whales (Mysticeti) and dolphins (Odontoceti), which could be explained by the fact that fishers perceive not only killer whale's size as well as its behavior, which remembers dolphins' behavior.

The specific name 'jibarte' quoted for *Megaptera novaeangliae* was slightly more used than the generic name 'baleia', confirming this species of Mysticeti as the most recognized by local

fishers. The synonim ‘jubarte’ was probably acquired from external influences (TV programs or researchers’ talk) and the specific name ‘cachalote’, which is the common name for *Physeter macrocephalus* (not included in this survey) was quoted only for the males of *M. novaeangliae*, an information learned from the ‘elders’, according to the interviewed fishers (n= 4).

‘Boto’ and ‘golfinho’ were quoted by interviewed fishers as generic names for dolphins in general. Dolphins’ common names show high geographic variation, even those used in scientific texts [34, 35, 60]. Many times one common name is used for different species, in different regions of Brazilian coast, as in the case of ‘boto’ and ‘golfinho’, which can be common names for *Tursiops truncatus, Sotalia guianensis, Stenella frontalis* and other species of delphinids. The use of ‘boto’ was four times more common among the interviewed fishers than the use of ‘golfinho’. Generally ‘golfinho’ is preferred by scientific jargon and communication media. When using both names, few interviewed fishers (n= 5) associated ‘boto’ to more robust dolphins and ‘golfinho’ to slimmer ones. Fishers from Cananéia mentioned the same association between generic names and dolphins’ size [35].

The mention of the specific name ‘toninha’ for three different dolphins’ species can be explained by morphological and behavioral similarity in the case of *S. guianensis* and *P. blainvillei*, as both species are the smaller ones and occur in coastal habitats in the studied area (Figure 7). *Delphinus* sp., despite its bigger size, can be considered a slimmer dolphin, which could lead some fishers to perceive it as a ‘small’ dolphin. On the other hand, the association of ‘toninha’ to *Delphinus* sp. could result from a mistaken identification of this dolphin’s picture, since this species is relatively rare in the surveyed area, so it could have been confused with other common species. The use of the name ‘toninha’ shows great variation along the Brazilian coast. In the south of Brazil it generally refers to *Pontoporia blainvillei* [32, 35, 44]. However for the State of Espírito Santo

(Brazilian southeastern coast) Freitas-Netto [60] reports its use for dolphin species of greater size such as *Steno bredanensis, Tursiops truncatus* and those of the genus *Stenella*.

Begossi *et al.* [10] studying the ethnotaxonomy of fishes on the Brazilian Atlantic Forest coast, compared generic richness of fishes with citations *'I do not know*' and found that the diversity of folk genera cited increases as the fishers show less knowledge about the fishes. Concerning cetaceans' taxonomy, citations *'I do not know'* showed great variation among the studied species, varying from 8% for *P. blainvillei* (the most known species) to 98% for *B. acutorostrata* (the least known species), indicating heterogeneity in relation to fishers' knowledge about these species.

A group among the interviewed fishers formed one main cluster, including two biological species (*T. truncatus* and *Sotalia guianensis*), which were grouped by morphological similarity (23citations, 27% of the total). These species are in fact morphologically very similar to any non-biologist, differing only in relation to their size and minor morphological aspects, such as the coloration pattern and the shape of their head, flippers and dorsal fins. Jefferson *et al.* [47] mentioned that individuals of *T. truncatus* can be confused along the east coast of South America with dolphins of the genus *Sotalia.* On the other hand, another group of the interviewees (37%) did not find enough similarity among the studied species in order to group them. This showed a great variation relative to the perception between these two groups of fishers which deserves further investigation, to clarify why fishers living in the same area and exposed to the same cetaceans' species have different perceptions in relation to morphological similarity among these species.

Conclusions

Cetaceans' genera normally include few Linnnean species, but their families include genera showing a high morphological similarity, which makes species recognition in nature a difficult task, succesfully performed only by cetaceans' experts. Fishers' perception about cetaceans was highly

influenced by phenotypic and cultural salience of the whales and dolphins, since fishers did not see these animals from a utility point of view. Historically, the utilization of accidentally captured cetaceans has not occurred in the studied area, according to interviewed fishers'. Thus, phenotypic salience favored cetaceans' recognition as natural discontinuities in nature, supporting, in some cases, the reality of the species ('toninha', 'jibarte', 'orca', 'boto-caldeirão').

Our results indicated that the most salient were not necessarily the most abundant species, but included the most frequently caught ones (*P. blainvillei* and *S. guianensis*) and those of greater size (although being rare), such as *T. tursiops* and *E. australis*. These species, together with those exposed by media (*M. novaeangliae* and *O. orca*), were the most recognized and important ones in the process of classification and nomenclature by the interviewed fishers, being named to the folk species level.

Coincidently, some of these species are the most threatened in the surveyed area, but not enough studied, which makes the fishers' knowledge about them greatly valuable for their conservation. According to Berkes *et al.* [18] local ecological knowledge can provide management alternatives to cope with dynamic changes in ecosystems, contributing to the conservation of marine habitats. Our results showed that fishers' LEK could be used to indicate areas and seasons of great occurrence of vulnerable cetaceans' species, helping to determine areas and periods for their protection. As researches about cetaceans' biology are of long-term duration and generally expensive, fishers' knowledge could also indicate priority topics for research, especially in those regions of the coast where no research has been conducted. On the other hand, fishers' LEK seems to be increasingly influenced by media, risking becoming global and loosing important social mechanisms of cultural transmission. However, some change is expected in the studied fishers' knowledge due to the increasing contact among them and the emergent tourism, what not necessarily means a negative experience. As fishers demonstrated empathy for cetaceans, maybe the

contact with updated information could increase fishers' awareness about the threatens to cetaceans', promoting their cooperation in the conservation of these species through an alternative management of gillnet fisheries in order to minimize incidental captures.

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Figures

Figure 1. Northern coast of São Paulo State, showing fishing communities studied (white dots) at São Sebastião.

Figure 2. Fishermen of Enseada beach, taking a gillnet out of their canoe (São Sebastião, Brasil).

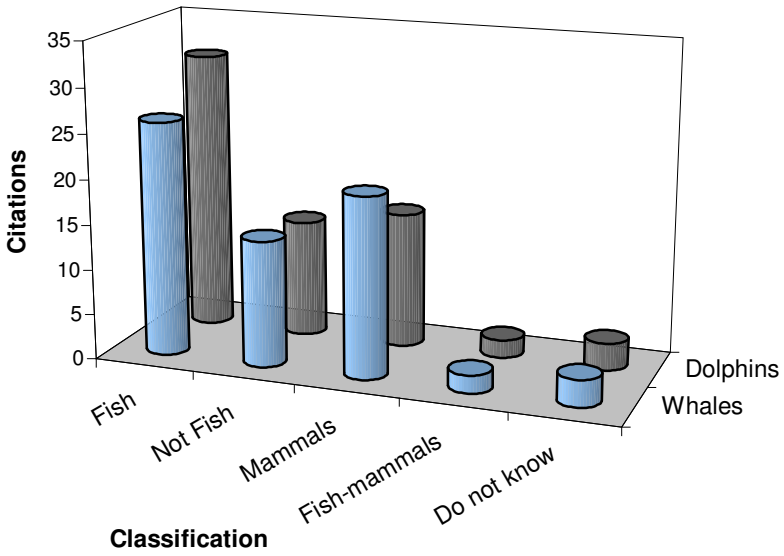

Figure 3. Whales' and dolphins' classification according to fishers (n=70) from São Sebastião, Brasil.

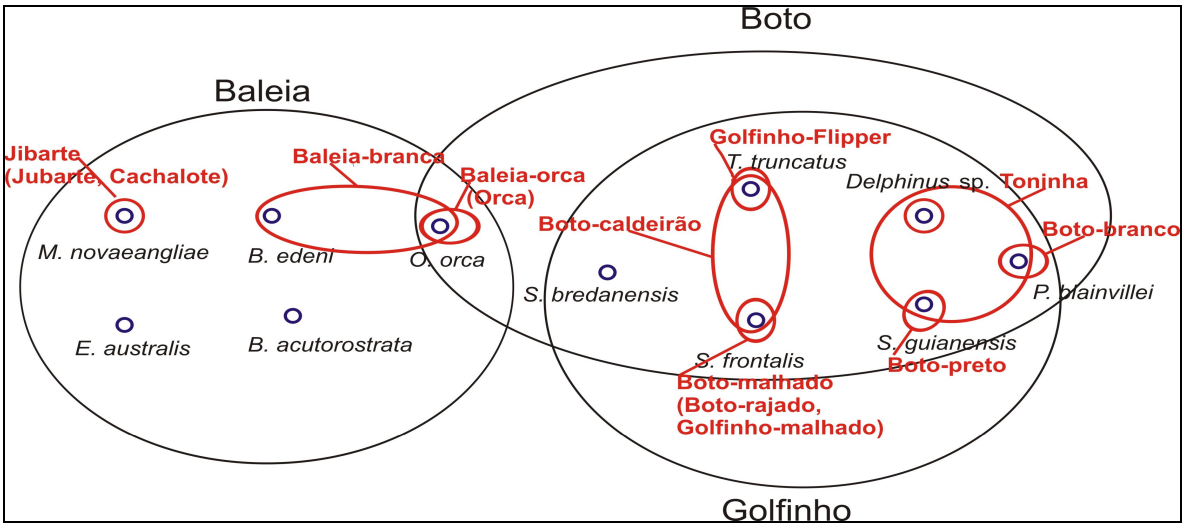

Figure 4. Cetaceans' classification according fishers from São Sebastião, Brazil. Blue circles correspond to biological species, red circles / ellipses are folk species and black ellipses correspond to generic rank.

Figure 5. Atlantic spotted dolphins (*Stenella frontalis*) swimming near to Vitória Island, Ilhabela, Brazil. Note the spotted pattern on the ventral side of the animal. (Photos by 'Projeto SOS Mamíferos Marinhos')

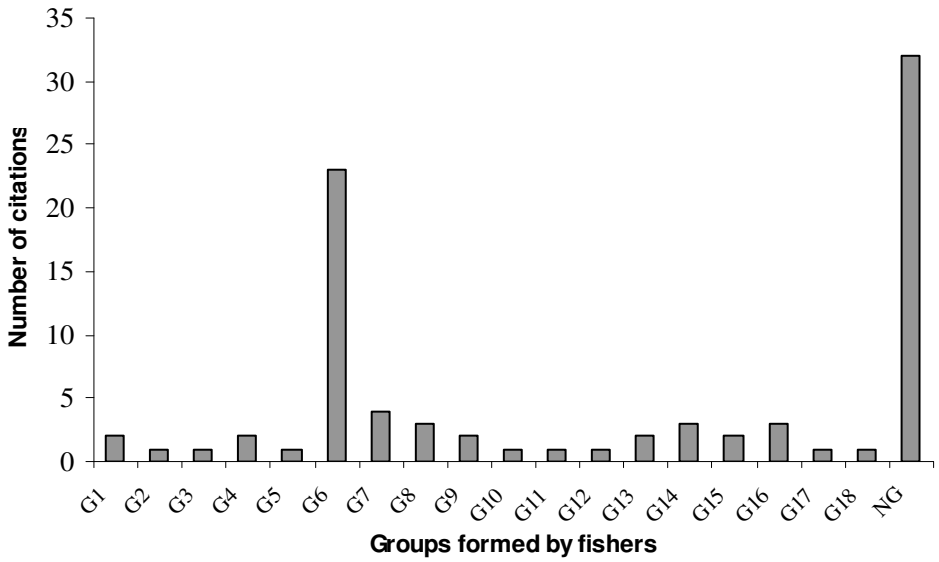

Figure 6. Groups of cetaceans' species formed by fishers, according morphological similarities. (G1 = *E. australis* + *M. novaeangliae,* G2 = *E. australis*+ *M. novaeangliae* + *O. orca,* G3 = *B. acutorostrata* + *M. novaeangliae,* G4 = *B. edeni* + *B. acutorostrata,* G5 = *B. edeni* + *B. acutorostrata* + *O. orca* + *S. bredanensis,* G6 = *S. guianensis* + *T. truncatus,* G7 = *S. guianensis* + *T. truncatus* + *Delphinus sp.,* G8 = *S. guianensis* + *T. truncatus* + *P. blainvillei,* G9 = *S. guianensis* + *T. truncatus* + *S. frontalis,* G10 = *S. guianensis* + *Delphinus sp.,* G11 = *P. blainvillei* + *Delphinus sp.,* G12 = *S. bredanensis* + *Delphinus sp.,* G13 = *S. frontalis* + *Delphinus sp.,* G14 = *S. bredanensis* + *S. frontalis,* G15 = *S. bredanensis* + *T. truncatus,* G16 = *S. guianensis* + *P. blainvillei,* G17= *P. blainvillei* + *S. bredanensis,* G18 = *P. blainvillei* + *T. truncatus,* NG = do not group)

Figure 7. A female of *Pontoporia blainvillei* (top) and a male of *Sotalia guianensis* (bottom) incidentally caught by gillnets at São Sebastião, Brazil. (Photos by 'Projeto SOS Mamíferos Marinhos')

Tables

Table 1. Contingency table using the number of citations for life-form categories quoted for whales and dolphins.

Life-form Categories	Whales	Dolphins	χ^2	*P*
Fish	26	31		
Not Fish	14	13		
Mammal	20	15	1.182	0.554*

Notes: Ho: proportion of citations for 'Fish', 'Not Fish' and 'Mammal' categories are independent if the animal is whale or dolphin.
* Non-significant *P* value, Ho is not rejected.

Table 2. Cetaceans' names given by the fishers interviewed (n=70).

Scientific name	**English common name**	**Folk genera**	**Folk species**	**Number of citations**	**Fisher do not know the animal**	**Number of fishers who have seen the animal (S) or have not seen the animal (NS)**	
Eubalaena australis	Southern right whale	**baleia**		**37**	33	S = 37	NS = 33

Balaenoptera acutorostrata	Minke whale	**baleia**		**1**	69	S = 1	NS = 69
Balaenoptera edeni	Bryde's whale	**baleia**		**19**	52	S = 18	NS = 52
			baleia-branca	1			
Megaptera novaeangliae	Humpback whale	**baleia**		**13**	33	S = 37	NS = 33
			jibarte	15			
			jubarte	8			
			cachalote	2			
Orcinus orca	Killer whale		orca	**27**	25	S = 14	NS = 56
		baleia		15			
			baleia-orca	12			
			baleia-branca	1			
		boto		**2**			
Steno bredanensis	Rough-toothed dolphin	**boto**		**14**	54	S = 16	NS = 54
		golfinho		**2**			
Tursiops truncatus	Bottlenose dolphin	**boto**		**56**	7	S = 63	NS = 7
			boto-caldeirão	9			
		golfinho		**10**			
			golfinho-flíper	1			
Delphinus sp.	Common dolphin	**boto**		**17**	50	S = 20	NS = 50
		golfinho		**1**			
			toninha	2			
Stenella frontalis	Atlantic spotted dolphin	**boto**		**25**	43	S = 27	NS = 43
			boto-rajado	2			
			boto-caldeirão	1			
			boto-malhado	1			
		golfinho		**2**			
			golfinho-malhado	1			
Sotalia guianensis	Marine tucuxi	**boto**		**45**	8	S = 61	NS = 9
			boto-preto	1			
		golfinho		**12**			
			toninha	8			
Pontoporia blainvillei	Franciscana		toninha	51	6	S = 64	NS = 6
		boto		**6**			
			boto-branco	1			
		golfinho		**14**			

Table 3. Contingency table using the number of citations for each cetacean species quoted for the Northern and Southern coast of São Sebastião.

Cetacean Species	Northern coast	Southern coast	χ^2	*P*
E. autralis	13	24		
B. edeni	9	9		
M. novaeangliae	16	21		
T. truncatus	31	32		
S. bredanensis	8	8		
Delphinus sp.	11	9		
S. frontalis	13	14		
S. guianensis	32	30		
P. blainvillei	27	37	4.172	0.8413*

Notes: Ho: proportion of citations for each species is independent if the fisher is from the Northern or the Southern coast of São Sebastião. * Non-significant *P* value, Ho is not rejected.

Table 4. Citations of the most frequent cetaceans' species according to fishers from São Sebastião and records of the same species incidentally captured or stranded in the studied area (from September 1994 to September 2006).

Cetacean species	**Records of dead cetaceans (1994-2006)***	**Cetaceans' citations by fishers**	χ^2	*P*
M. novaeangliae	6	38	23.273	< 0.0001**
T. truncatus	14	66	33.80	< 0.0001**
S. bredanensis	6	16	4.545	0.0550
S. frontalis	8	27	10.314	0.0023
S. guianensis	30	65	12.895	0.0005**
P. blainvillei	49	71	4.033	0.0552
Total	113	283		

Capítulo 3

THE ETHNOECOLOGY OF CETACEANS BY FISHERS FROM SÃO SEBASTIÃO, SOUTHEASTERN BRAZILIAN COAST

Toninha (*Pontoporia* blainvillei) e boto-cinza (*Sotalia guianensis*) capturados em redes de pesca, a primeira com a mandíbula amputada pela rede e o segundo emalhado em rede de espera.

The ethnoecology of cetaceans by fishers from São Sebastião, Southeastern Brazilian coast

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Abstract

Local ecological knowledge (LEK) has been empirically built by several human societies and transmitted through generations, shaping their culture. LEK has been especially useful to design systems of co-management involving local people, government institutions and scientists. Surveys on fishers' knowledge about cetaceans' ecology are relatively scarce. Our aim is to verify the extent of the knowledge of fishers from São Sebastião, Brazil, regarding 11 species of cetaceans, analysing information about their occurrence areas, habitat, seasonality, diet, group size, reproduction, potencial predators and interactions with fisheries. Such knowledge was compared to local research and to scientific literature data, demonstrating a high degree of concordance among them. From the studied species, *Pontoporia blainvillei*, *Sotalia guianensis*, *Tursiops truncatus*, *Eubalaena australis* and *Megaptera novaeangliae* were the better known by local fishers. The topics showing higher number of citations were 'Diet' and 'Occurrence areas' and the least known by fishers were 'Reproduction', 'Interaction with fisheries' and 'Predators'. Data obtained from fishers can contribute to researches to supply the lack of information on cetaceans' ecological aspects. Fishers' participation is also valuable regarding the management of local conservation areas besides being a way to revive and valorize the local culture.

Key words: Local ecological knowledge, cetaceans, fishers, southeastern Brazilian coast, dolphins' incidental capture

1. Introduction

Ethnoecology is an interdisciplinary branch of Human Ecology that studies the folk knowledge about the biotic and abiotic environment, including the connection between humans and nature (Toledo 2002). Ethnoecological studies aim to explain how nature is perceived by human societies through a framework of knowledge, beliefs and practices in order to determine strategies for the use of natural resources (Berkes *et al.* 2000). The local ecological knowledge (LEK) of local societies can be considered empirically-based and practically oriented, and its transmission through generations plays an important role, shaping society and culture (Ruddle 2000). Moreover, LEK is a dynamic body of knowledge incorporating changes and generating adaptive responses by which local people build their resilience, which is the capacity to recover after disturbance, absorb stress and transcend it (Berkes *et al.* 2000, Ruddle 2000). Among other uses, LEK has been employed by scientists to assess environmental impacts and changes over large areas around the world, to generate new hypotheses for scientific studies and to design systems of adaptive co-management involving local people, government institutions and scientists (Davis and Wagner 2003, Gadgil *et al*. 2003). Begossi *et al*. (2004) suggested that co-management strategies involving fishing communities, based on fishers' active participation in decisive processes, could be an alternative to the current top-down management systems utilized by the government, but constant monitoring and evaluation of co-management systems should be done to guarantee success in marine resources' conservation.

Surveys assessing cetaceans' ecology through folk ecological knowledge are relatively scarce around the world. Huntington *et al*. (1999, 2004) have studied the LEK of Artic hunters on beluga whales (*Delphinapterus leucas*) gathering LEK based information about the ecology of this species and comparing this information to scientific data. Johannes *et al*. (2000) analized four

examples in which the knowledge of local communities contributed to solve conflicting issues regarding cetaceans' ecology.

In Brazil, such studies began in the nineties and some of them are still being carried out in coastal fishing communities in the States of Santa Catarina, Paraná, São Paulo, Rio de Janeiro, Bahia and Maranhão (Przbylski and Monteiro-Filho 2001, Pinheiro and Cremer 2003, Alarcon and Schiavetti 2005, Peterson 2005, Garri *et al*. 2006, Hassel 2006, Oliveira and Monteiro-Filho 2006, Souza and Begossi 2006). The main focus of these researches has been the interaction between cetaceans and fishing gear, besides fishers' knowledge about cetaceans' ecological aspects.

Until now, 44 species of cetaceans have been recorded in Brazilian waters (Souza *et al*. 2005), some of them classified as threatened by both IUCN and IBAMA (Brazilian Environmental Agency) lists, such as *Balaenoptera musculus* (endangered), *Eubalaena australis*, *Balaenoptera physalus*, *Balaenoptera borealis, Megaptera novaeangliae*, *Physeter macrocephalus*, *Pontoporia blainvillei* and *Inia geoffrensis* (vulnerable) (IBAMA 2001, Reeves *et al*. 2003). One of the main threats to these cetaceans is incidental capture by gillnets, which affects especially coastal dolphins. The other cetaceans' species that occur in Brazilian waters are classified as 'Deficient Data' which means that they are insufficiently known to be categorized. From all the species occurring in Brazil, few can be considered well known, such as the humpback whale (*Megaptera novaeangliae*), the Southern right whale (*Eubalaena australis*), the marine tucuxi (*Sotalia guianensis*), the franciscana (*Pontoporia blainvillei*), the spinner dolphin (*Stenella longirostris*) and the bottlenose dolphin (*Tursiops truncatus*) (Hetzel and Lodi 1993, Siciliano 1997, Zerbini *et al.* 1997, Simões-Lopes and Fabian 1999, Barreto 2000, Di Beneditto *et al.* 2001, Di Beneditto and Ramos 2001, Danilewicz *et al.* 2002, Flores 2002, Santos *et al.* 2002, Secchi *et al.* 2002, Silva Jr. *et al.* 2004, Zerbini *et al.* 2004, Groch *et al.* 2005, Silva Jr. 2005, Siciliano *et al.* 2006).

Artisanal fisheries are one of the main commercial activities practiced along the Brazilian coast (Marques 2001, Begossi 2004, 2006, Silvano *et al*. 2006). In the northern coast of the State of São Paulo, marked by the presence of the Atlantic Rain Forest, small communities of artisanal fishers have been interacting with whales and dolphins, especially with some coastal species which are incidentally caught by gillnets (Souza and Winck 2005). The occurrence of whales and dolphins in this area has been reported by the 'Projeto SOS Mamíferos Marinhos' in the last 12 years, recording the following families and species: Family Balaenopteridae: *M. novaeangliae, Balaenoptera edeni, B. acutorostrata,* Family Balaenidae: *E australis,* Family: Pontoporiidae: *P. blainvillei,* Family Delphinidae: *S. guianensis, Stenella frontalis, T. truncatus, Steno bredanensis, Delphinus capensis, D. delphis, Pseudorca crassidens, Orcinus orca,* Family Kogiidae: *Kogia sima,* Family Ziphiidae: *Berardius arnouxii and Mesoplodon mirus* (S.S. unpublished data 2006).

Our objective was to analyze the extent of local fishers' knowledge regarding cetaceans at the Northern coast of São Paulo. We did this by compiling fishers' knowledge about cetaceans' ecology, including different ecological aspects, such as occurrence areas, habitat, seasonality, diet, group size, reproduction, potencial predators and interactions with fisheries. We analyzed fishers' knowledge considering the different cetacean species that occur in the southeastern Brazilian coast, verifying if some ecological aspects were more perceived than others. Finally, we compared fishers' knowledge to the scientific knowledge on cetaceans, discussing the observed concordances and discordances.

2. Materials and Methods

2.1 Studied Area

São Sebastião (23º42'18" to 23º45'38"S – 45º25'41" to 45º53'49"W) is located at the northern coast of São Paulo State, which comprises 161km of coastline including 164 sandy beaches

and 17 islands (Figure 1). This part of the coast receives the Coastal Water Mass, which results from the mixture of Tropical Water Mass and South-Atlantic Central Water Mass, with temperatures ranging from 19 to 29°C and salinity between 32 to 36 ‰ (Silva 1995).

The municipality of São Sebastião is composed by a narrow plain area situated between the sea (Atlantic Ocean) and the slopes of Atlantic Rain Forest and its 80 km of coast line is composed by 34 beaches and inhabited by nearly 70.000 people (IBGE 2006). Ilhabela, the biggest maritime island of Brazil is located in front of São Sebastião, separated from the mainland by a deep and narrow channel. Additionally, the biggest oil terminal (TEBAR – TRANSPETRO) of Latin America is situated in the town and is the main source of income to the city, followed by tourism and fisheries.

2.2 Fisheries activities

Most of the artisanal fishers in São Sebastião, as well as in the northern coast of São Paulo State, practice small scale coastal fisheries, using paddled canoes or motored boats measuring from 5 to 15 meters. The main equipment used are trawling nets, several kinds of gillnets and hook and line (Figure 2). The target species of artisanal fisheries, according to local fishers and confirmed by official reports, are shrimps (especially *Farfantepenaeus* sp., *Xiphopenaeus kroyeri*) and fishes from the families Sciaenidae, Mugilidae, Clupeidae and Carangidae (Ávila-da-Silva 2005). Currently, according to collected data[1], there are nearly 230 active artisanal fishers in communities around the coast of São Sebastião, but the involvement of local people in such activity have been decreasing over the years, according to the opinion of the local elders. Among the reasons for that decrease are the reduced monetary incomes from fishing activities, the increase of tourism and the influences of a new life style brought by the modernization process in the region (Begossi 2006).

[1]Data obtained during the project "Estratégias de Conservação para a Toninha (*Pontoporia blainvillei*) nas Áreas de Manejo I e II: buscando alternativas para salvar uma espécie", supported by PROBIO/MMA/BIRD/GEF/CNPq.

2.3 Methodology

We initially recorded fishers' perception about the ecology of cetaceans, and then we quantified and analyzed all compiled information. Some criteria were defined in order to choose those fishers considered experts in artisanal fisheries in the studied area to be interviewed. These criteria were more than 35 years old, living in the studied area for more than 10 years and fishing, as main activity, for more than 15 years. Following these criteria we selected fishers resident in 14 communities along the São Sebastião coast (Figure 1). Some of these fishers had participated in previous interviews[2] about the interaction between cetacean and fisheries and were known by their large fishing experience. Other fishers were indicated by these experts through the 'snow-ball' method, used in other studies (Bailey 1982, Begossi 2004). The communities surveyed were: Enseada, Cigarras, São Francisco, Pontal da Cruz, Barequeçaba, Toque-Toque Grande, Toque-Toque Pequeno, Paúba, Maresias, Boiçucanga, Barra do Sahy, Juqueí, Barra do Una and Boracéia (Figure 1).

The interviews with fishers were performed during January, February and May 2005 and from March to July 2006. At the first contact with each fisher we asked for their consent to participate in the interviews, which were performed individually with each fisher, through semi-structured questionnaires, as well as unlabelled figures and photos of 11 cetaceans' species which occur in the studied area. Interviews took place at fishers' '*ranchos*', where they keep their fishing equipments and can be found before or after going out to the sea. Each interview had an average duration of 45 minutes. After fishers' permission, we take pictures of them, their equipments, boats and activities during the interviews, in order to record photographically the studied communities.

[2]These interviews were carried out during the project "Estratégias de Conservação para a Toninha (*Pontoporia blainvillei*) nas Áreas de Manejo I e II: buscando alternativas para salvar uma espécie" in 2004 and 2005 (PROBIO/MMA/BIRD/GEF/CNPq).

Questions about cetaceans' ecological aspects such as distribution, habitat, diet, seasonality, reproduction, predators and interactions with fisheries were asked to the fishers (Appendix 1).

We included in this survey the commonest cetaceans' species recorded more than 4 times in the studied area, which were: right whale (*Eubalaena australis*), humpback whale (*Megaptera novaeangliae*), Bryde's whale (*Balaenoptera edeni*), minke whale (*B. acutorostrata*), killer whale (*Orcinus orca*), bottlenose dolphin (*Tursiops truncatus*), rough-toothed dolphin (*Steno bredanensis*), Atlantic spotted dolphin (*Stenella frontalis*), common dolphin (*Delphinus* sp.), marine tucuxi (*Sotalia guianensis*) and franciscana (*Pontoporia blainvillei*). Their identification and English common names followed Jefferson *et al.* (1993).

2.4 Data analysis

The answers obtained from the fishers were recorded as ´citations´, being possible to a fisher provide more than one citation when answering each question. In order to standardize the results, we show the data as the total number of citations for each question relative to each surveyed species, followed by its correspondent percentage value when necessary. Only the answers given by at least 20% of the interviewees were considered in the statistical analyses. Citations were considered positive when provided any information about the asked topic. Negative citations were those when the answer to a question was 'I do not know'. Following Silvano and Begossi (2002) we considered such negative citations as uncertain knowledge, being quantified as number of doubts.

Additional information about cetaceans ecological aspects in the studied area were obtained from a local research project ('Projeto SOS Mamíferos Marinhos') and from scientific papers, in order to compare with fishers' knowledge (Appendix 2). These comparisons followed Marques (1995) and included all the citations for each aspect surveyed, even those not considered in the statistical tests.

In order to check if fishers who had spent more years at school would recognize more cetaceans' species, we compared their knowledge (through the number of species recognized) with the number of years that each one spent at school, through Spearman's Correlation. We used the Chi-square test to check if there is dependence between the number of positive citations per topic (ecological aspects) and the cetaceans' species to which they refer. We compared the number of doubts among the cetacean's species and the ecological aspects through a Chi-square test. The possible dependence among the species and 3 major occurrences areas, 2 types of habitat and 3 seasonal periods mentioned by fishers was tested through Chi-square test. All statistical tests were performed using the software BioEstat 4.0.

3. Results

A total of 70 fishers from the coast of São Sebastião were interviewed. Among them, 46 are native from São Sebastião, 10 are from neighboring municipalities such as Caraguatatuba, Ilhabela and Santos, and 14 are from inland cities or from other states. There was just one woman among the 70 fishers interviewed. Ages varied from 35 to 97 years, average age being 59 years old, and all of them are artisanal fishers. The average period dedicated to fisheries, among all the interviewees, was 38 years. The minimum time of residence in São Sebastião was 13 years and the maximum was 97 years. Regarding to time attending a school, 4 fishers never went to school, 37 attended primary school but only 19 finished it, 31 started secondary school but only 4 finished it, 7 completed high-school, 1 started college but did not finish it and 9 (13%) did not know how to answer this question. The Spearman's correlation shows that fishers knowledge about cetacean's speices was not associated to the time they have spent at school ($rs= -0.0863$, $p=0.4772$).

Among the 11 cetaceans' species surveyed, 9 were considered in the statistical analysis, and 2 were excluded: minke whale (*B. acutorostrata*) that was recognized by only one among 70 fishers,

and killer whale (*O. orca*), to which, despite of being well recognized by 65% of the interviewees, less than 20% of them answered about its ecological aspects. In relation to the rough-toothed dolphin (*S. bredanensis*) only one ecological aspect ('occurrence areas') was answered by 20% or more fishers and it will be thus considered in data analysis. Less than 20% of fishers provided answers about diet of killer whale, rough-toothed dolphin and common dolphin, so data about these species were not included in diet analysis.

A total of 2.549 positive citations regarding ecological aspects (occurrence areas, group size, habitat, seasonality, diet, predators, reproduction and interactions with fisheries) were obtained for 9 species considered in this survey (Figure 3A, Appendix 3A). The topics with higher number of positive citations were 'Diet' and 'Occurrence areas', with 534 and 504 citations respectivelly. The less cited were 'Reproduction', 'Interactions with fisheries' and 'Predators' with 163, 147 and 66 citations respectivelly. In fact 'Reproduction' and 'Interaction with fisheries' were the ecological aspects less known by the interviewees, considering the number of doubts ($\chi^2 = 137$, d.f. = 6, $p < 0.0001$) (Appendix 3B).

Results from the Chi-square test indicated that the number of citations for each ecological aspect was related to the species to which they refer ($\chi^2 = 243$, d.f. =48, $p < 0.0001$) (Appendix 3A). Therefore *Sotalia guianensis* and *Pontoporia blainvillei* can be considered the most cited species for all the ecological aspects surveyed. Due to the great variety of citations for each topic we show only those representing 20% or more of the citations' total. Among 9 species, the more known by fishers (less doubt) were the dolphins *P. blainvillei, T. truncatus and S. guianensis*, however other 3 dolphins (*B. edeni, S. bredanensis and Delphinus sp*.) presented the higher values for the number of doubts ($\chi^2 = 104$, d.f. =9, $p < 0.0001$) (Figure 3B).

3.1 Cetaceans' occurrence areas

A total of 504 positive answers regarding to the occurrence areas of cetaceans were obtained from the 70 interviewed fishers. The citations obtained corresponded to 46 different places of northern coast of São Paulo State and for better visualization, we grouped those places in 3 major arbitrary areas of occurrence: areas at the NE to SE of Ilhabela Island, São Sebastião channel and southern coast of São Sebastião (Figures 1 and 4, Table 1).

According to fishers' citations, whales and dolphins occur preferentially in the southern coast of São Sebastião (59 and 180 citations, respectively). This area received 47% of the citations, while the other two areas received 25% each. Data from *S. bredanensis* and *Delphinus* sp. were not considered in the statistical analysis, due to low number of citations (21 and 28 citations respectivelly). The 7 cetaceans species analysed showed differences in relation to their occurrence at the 3 major occurrence areas ($\chi^2 = 45$, d.f. = 12, $p < 0.0001$), with *P. blainvillei* predominating at the southern coast of São Sebastião, followed by *T. truncatus* and *S. guianensis* at the northern coast (area of the São Sebastião Channel). In the area at the NE to SE of Ilhabela Island, citations were homogeneously distributed among species ($\chi^2 = 3.6$, d.f = 6, $p = 0.73$) (Table 1).

3.2 Group size

Group size was the main aspect of social organization mentioned in 364 positive citations, and it varied among whales and dolphins. Generally, whales were sighted by fishers swimming alone (52 answers), in pairs of mother and calf (43 citations) or pairs of two adults (34 citations), which fishers assumed to be male and female. There were variation among the three species of whales in relation to the predominance of group sizes, but the categories 'alone' and 'mother-calf' were the most cited (Figure 5) ($\chi^2 = 57$, d.f. = 4, $p < 0.0001$).

In relation to dolphins, in general, the frequencies of citations for all group sizes mentioned were fairly homogeneous. However, comparing citations for each species, it is possible to note variations among the frequency for each group size mentioned (Figure 6) (χ^2 = 22, d.f. = 6, p = 0.0012). Small group sizes (less than 20 individuals) predominated for some species (*P. blainvillei, Delphinus* sp. and *T. truncatus*) while for others (*S. guianensis* and *S. frontalis*) larger group sizes, from 20 to hundreds individuals, were the most cited (Figure 6).

3.3 Habitat

We recorded 414 positive citations to the question 'Where does it live?' and most of them referred to the depht of the sea where the cetaceans occur. Citations such as 'shallow waters' referred to coastal habitats, while 'deep waters' meant oceanic habitats. Except for 3 species (*P. blainvillei*, *S. guianensis* and *T. truncatus*), the frequency of citations 'I do not know' were relatively high (more than 50% of the total for each species) (Figure 7). Considering the number of citations about habitat, whales could be considered as poorly known by fishers, as well as the less mentioned species of dolphins (*Delphinus* sp. and *S. frontalis*). In spite of the greater number of citations for all surveyed species, 'deep waters' did not show significant difference to 'shallow waters' for all the species, except for *M. novaeangliae*, which was more mentioned in deep waters. The occurrence in coastal or oceanic habitats, according to fishers, was not dependent on the species (χ^2 = 7, d.f. = 7, p=0.39) (Figure 7).

3.4 Seasonality

Patterns of seasonal variation in cetaceans' occurrence were mentioned in 284 positive citations. For only 3 species (*P. blainvillei*, *S. guianensis* and *T. truncatus*), this topic can be considered fairly known, since they presented less negative answers ('I don't know') than the other

species. According to fishers, they are species of dolphins that occur predominantly around the year, as well as *S. frontalis* (Figure 8). For the 3 whale's species, winter was the season most cited but differences in relation to citations for summer were not significant (χ^2 = 0.9, d.f. = 2, p = 0.620). Only for *P. blainvillei* and *S. guianensis* the differences among citations for each season were significant, predominanting citations for 'year round' (χ^2 = 11, d.f. = 2, p = 0.0046; χ^2 = 25, d.f. = 2, p < 0.0001, respectively). Apart from killer whales, occurrences of two other dolphin's species (*S. bredanensis*, *Delphinus* sp.) were cited by less than 20% of the interviewed fishers, so difficulting definition of their seasonal patterns of occurrence.

3.5 Diet

Fishers' knowledge concerning the diet of cetaceans was more consistent if compared to other ecological aspects, according to positive citations (χ^2 = 332, d.f. =6, p < 0.0001). A total of 534 positive citations were obtained from fishers, including 11 prey categories: 'fish' (in general) (n=71), 'big fish' (n=2), 'small fish' (n=51), 'fish's blood' (n=7), 'squid' (n=35), 'shrimp' (n=5), 'bycatch discharged by trawlers' (n=1), 'fish's spawn' (n=1), 'plancton' (n=1), 'their own froth' (n=1), 'anything' (n=3). Regarding prey items, fishers mentioned 28 folk species (animals) among fishes, crutaceans and mollusks of 18 biological families (Table 2). According to fishers, bony fishes predominated among prey items utilized by cetaceans in the studied area. Regarding to whales, citations for prey species included from 3 to 6 items while citations for dolphins ranged from 2 to 18 items (average of 10 items).

Fishes from the families Mugilidae, Engraulidae and Clupeidae were mentioned in 66% of citations for cetaceans' diet. The prey items most quoted were 'tainha' (*Mugil platanus,* mullet, 125 citations), 'manjuba' (*Anchoa* sp., anchovy, 73 citations) and 'sardinha' (*Sardinella brasiliensis,* sardine, 67 citations) (Table 2).

The diet of the dolphin *Sotalia guianensis* presented more itens, according to fishers (140 positive citations) among other cetaceans' species, followed by the dolphins *Tursiops truncatus* and *Pontoporia blainvillei* (Figure 9).

Some feeding behaviors of these dolphins mentioned by fishers were: 'dolphins eat at sea surface' (n=2), 'they start eating at dawn' (n=3), 'dolphins show fish preferences' (n=4), 'where dolphins leap, there are schools of fish below' (n=4), 'where you see groups of seabirds, there are dolphins chasing fishes' (n=3), 'two dolphins from the group go ahead to search for fish, and call for the others when they find it' (n=2), 'dolphins throw the mullet in the air, and when it fall down they eat only its posterior half, because they like their eggs' (n=8), 'dolphins swallow the fish by its head, for not choking with the fish's gills' (n=5), among others less cited. Regarding to whales, the feeding behavior more cited was 'whales eat schools of small fishes because they have a very narrow throat' (n=17).

3.6 Interactions with Fisheries

Positive fishers' citations related to cetaceans' interactions with fisheries were 220; 147 of them related to ten cetaceans' species and 73 related to whales and dolphins in general. But only for *P. blainvillei, S. guianensis* and *T. truncatus* the number of answers (> 20%) allowed them to be considered in data analysis (Appendix 3A).

Confirmation of incidental capture was provided by 93 citations from 53 fishers. Only 15 fishers categorically affirmed that incidental capture of dolphins did not occur at the studied area. Among fishing nets that occasionally capture cetaceans, gillnets were the most mentioned (37 among 49 citations) (Figure 10-A). According to fishers' citations, the species most affected by this accident were *P. blainvillei* (58 citations) and *S. guianensis* (17 citations). Fishers believed that such accidents occur because dolphins, when pursuing fishes, entangle their beaks or flippers in the net

and do not manage to escape, drowning in the meantime. Among fishers, 22 affirmed that cetaceans cause damage to fisheries, against 25 which denyed this affirmation. Fishers mentioned that they observed 13 different behavioral aspects (82 citations) for the studied cetaceans' species during fisheries activities (Figure 10-B).

3.7 Reproduction

Fishers' knowledge on cetaceans' reproduction was limited. This ecological aspect obtained the higher number of doubts ('do not know' answers, n=544) among all the species surveyed (χ^2 = 332, d.f. =6, $p < 0.0001$). In general, fishers did know well the reproductive aspects of whales if compared to dolphins (Figure 11). We considered in the analysis only data from humpback and right whales, marine tucuxi and franciscana, since the number of citations for the other species were provided by less than 20% of the interviewed fishers. For both whales and dolphins, the best known aspect is the 'presence of calves', followed by the geographical localization of mother-calf's sightings. The area most cited for whales' mother-calf sightings was the southern coast of São Sebastião (17 citations), followed by the area at the NE to SE of Ilhabela Island (13 citations) and such interaction occurred predominantly during the winter. According to fishers, dolphins' mother-calf sightings occurred both in the winter and in the summer and fishers were not able to remember their precise localization.

3.8 Predators

This topic was mentioned by fishers for cetaceans in general, not specifying the species, and for this reason it could not be compared to the other ecological aspects, which were answered individually for each species, nor to literature data. From 66 positive answers, 51 stated that 'whales and dolphins do not have predators', 9 citations affirmed that 'men (through fishing nets) were the

main predator', 5 blamed the sharks and 1 indicated killer whales as predators. Only 10 fishers, among 70, did not know the answer to this topic.

4. Discussion

Studies about ethnoecological aspects of aquatic fauna in Brazil have focused mainly in fishes, comparing fishers' ecological knowledge to scientific information (Marques 1995, Souza and Barrela 2001, Silvano and Begossi 2002, Mourão and Nordi 2003, Begossi 2004, Silvano and Begossi 2005, Rosa *et al*. 2005, Silvano *et al*. 2006). A few surveys on cetaceans' ethnoecology, related to marine tucuxi (*Sotalia guianensis*), franciscana (*Pontoporia blainvillei*), bottlenose dolphin (*Tursiops truncatus*) and humpback whale (*Megaptera novaeangliae*) were carried out in Brazilian coastal states such as Santa Catarina, Paraná, São Paulo, Rio de Janeiro, Bahia and Maranhão (Pinheiro and Cremer 2003, Alarcon and Schiavetti 2005, Peterson 2005, Garri *et al*. 2006, Hassel 2006, Oliveira and Monteiro-Filho 2006, Souza and Begossi 2006).

Our survey aimed to understand and to analyze fishers' local ecological knowledge (LEK) about 11 cetaceans' species occurring in the São Sebastião coast and adjacent islands. Results from interviews confirmed that this knowledge is obtained during practical activities related to fishing, but it is also dynamic and susceptible to changes. In addition to day-to-day gathering of information, fishers LEK on cetaceans have been accumulated and transmitted through generations by the reproduction of 'memes' (or 'cultural variants'), which are fragments of information, stored in human brains and transmitted among people by conversation or other behavioral forms (Dawkins 1979). Due to the analogy between 'meme' and 'gene', we chose to use the word 'meme' in this study to promote an easier understanding of cultural transmission process. Appendix 4 brings a list of some 'memes' recorded at the interviews.

Most of the interviewed fishers (n=51) have spent all their lives fishing in the northern coast of São Paulo and have accumulated a great deal of knowledge on marine habitats and their fauna, unrelated to time they spent in school. The comparison among fishers knowledge, data from local research on cetaceans and from scientific literature related to the southeastern Brazil demonstrated great accordance among these three sets of data, as seen in the Appendix 2. However, for most of the cetacean species there is a lack of research at the studied area, resulting in relatively few published papers referring especifically to cetaceans at the northern coast of São Paulo.

According to Parra (2006), the knowledge about cetaceans' spatial dynamics and habitat preferences is essential to the delimitation and efective management of conservation areas to protect the threatened species. At least 3 vulnerable species, *Eubalaena australis*, *Megaptera novaeangliae* and *Pontoporia blainvillei* occur at the northern coast of São Paulo, beside other poorly known species. Some local ecological aspects about these cetaceans are still unknown by researchers or even by fishers. For example, minke whale was the least known species by fishers at the studied area. Despite being considered the most abundant baleen whale of the world (Zerbini *et al.* 1997), minke whale was recognized by only one, among 70 fishers from São Sebastião. A possible explanation, suggested by the former authors, could be its weak blow in warmer waters which could make its visualization difficult by fishermen. Additionally, records of this species are not common at the studied area, being limited to 4 stranded animals (S.S., unpublished data). On the other hand, Bryde's whales, considered to be the least known of the balenopterids (Siciliano *et al.* 2004), were more recognized by studied fishers than the minke whales, as interviewees provided information about almost all the asked ecological aspects of the former species. The migratory species, humpback and right whales, were especially noticeable to interviewed fishers due to the presence of mother-calf pairs in the studied area, during their reproductive season in the winter.

Coastal dolphins, such as franciscanas and marine tucuxis, as well as bottlenose dolphins, were the better known in relation to all surveyed topics. These dolphin's species are also among the most studied in Brazil, so we could compare much of fishers' information to scientific data (Appendix 2). Nevertheless, important information was added by fishers about the lesser known species: rough-toothed dolphin, Atlantic-spotted dolphin and common dolphin.

Killer whale was a special case: a well recognized species about which fishers know almost nothing. External cultural factors, such as TV programs, might have influenced the process of recognition of this species, the same occurring in relation to humpback whales.

Details on fishers' knowledge about each ecological aspect are discussed below.

4.1 Cetaceans' occurrence areas

The main factor determining the distribution of cetaceans, according to fishers', was the occurrence of prey, which is also mentioned by literature data (Di Beneditto *et al.* 2001a, Hastie *et al*. 2004). Fishers from Cananéia, in the southern coast of São Paulo, share the same oppinion as our interviewees about cetaceans' distribution (Oliveira and Monteiro-Filho 2006).

The interviewed fishers reported the distribution of cetaceans that they meet during their fisheries activities. These activities take place in coastal areas near to their residence places, and beause we interviewed 32 fishers from the northern coast and 38 from the southern coast of São Sebastião we expect that citations about distribution would refer to the entire studied coast, which in fact occurred.

According to fishers, *Pontoporia blainvillei* was the predominant species at the southern coast while *Sotalia guianensis* at the northern coast of São Sebastião (Channel area). São Sebastião is included in the area of simpatry for these two species, which ranges from the northern of Espírito Santo State to the northern of Santa Catarina State (Di Beneditto and Ramos 2001). Such local

variation in the occurrence areas of both species, suggested by fishers' citations, could reflect a strategy of niche partitioning, in order to reduce competition between these two species, as observed in another survey (Parra 2006).

Although literature data on occurrence areas are not so detailed in relation to all the studied species, concordances with fishers' information were found for 6 species (*E. australis, B. edeni, M. novaeangliae, O. orca, S. guianensis* and *P. blainvillei*). The comparison between local knowledge and local research data also showed high concordance in relation to the occurrence areas for all the studied species (Appendix 2).

Obviously, the most cited areas corresponded to those most freqüented by the interviewees during their fisheries activities. More research efforts should be done, especially in the areas not mentioned and those not frequented by the fishers, in order to obtain accurate patterns of distribution for each cetacean species.

4.2 Group size

Whales and dolphins differ on social organization regarding to group size, since whales tend to form smaller groups than dolphins (Whitehead and Mann 2000). This could be one of the causes because which sightings of whales, by fishers, in the studied area are scarcer than those of dolphins, since smaller groups or lonely individuals may be less perceived by the observers. The predominance of mother-calf groups or lonely individuals of humpback and right whales during their migration was noted by fishers and the strong bonds linking mother and calf were perceived and cited by most of the interviewed fishers. In addition, for the interviewees, two whales swimming together represent a couple (male and female) especially if the female is accompanied by a calf. Such group was considered by fishers to be a 'family', reflecting an anthropocentric interpretation in relation to whales' social life.

Groups' sizes for dolphins, according to fishers, varied according to the species. Some species are known, by researchers, to form large groups with hundreds of animals, such as *Delphinus* sp. and *S. frontalis,* while others form small groups of less than 10 individuals, such as *P. blainvillei* (Jefferson *et al*. 1993, Hetzel and Lodi 1993, Whitehead and Mann 2000, Siciliano *et al*. 2006). Fishers' citations for group size of whales and dolphins agreed with information from literature and research data for the studied area, for all the species (Appendix 2), confirming that this ecological aspect was well perceived by the fishers.

4.3 Habitat

Fishers' answers about habitat were limited for most of the cetaceans' species considered in this survey. Cetacean habitat was referred mainly as coastal ('shallow waters') or oceanic ('deep waters'). Most fishers recognized the great mobility of cetaceans during foraging activities and migrations. Whales were considered mostly living at oceanic habitats, but moving to shallow waters to breed, while for dolphins both habitats were equally mentioned. According to 51% of the fishers, cetaceans 'do not have preference for any kind of habitat, they only care about food. They move around searching fishes to eat'. This affirmation agrees with Hastie *et al*. (2004), who suggest that dolphin's distribution is closely related to their foraging behavior.

The lack of significant difference between fishers' citations for both habitats contradicts the known distribution of *P. blainvillei* and *S. guianensis*, which are considered predominantly coastal dolphins (Jefferson *et al.* 1993, Di Beneditto *et al*. 2001a). Maybe the notion of 'cetaceans living at deep waters' can be considered as a 'meme' transmitted through generations of fishers, which in fact not applies to all cetaceans' species. This 'meme' could be influencing the fishers' answers in relation to the distribution of *P. blainvillei* and *S. guianensis*.

Another possibility is a misinterpretation of the term 'deep waters' mentioned by fishers. As the continental shelf is extensive in the studied area, maybe the fishers were referring to places distant from the coast rather than deeper places, when they mentioned 'deep waters'.

4.4 Seasonality

For fishers, the presence of whales in the studied area is related to their reproductive period. The occurrence of mother-calf groups or lonely individuals of humpback and right whales during their migration from feeding to reproduction areas, confirm the northern coast of São Paulo as part of their migratory routes. On the other hand, fishers believe that dolphins' movements are conditioned by foraging activities, although fishers believed that some dolphin species are 'resident', while others 'are passing through'. However fishers do not defined which species of dolphins are 'resident' or which 'are passing through'.

The 'year round' occurrence of *S. guianensis* and *P. blainvillei* was also mentioned by fishers from Cananéia at the southern coast of São Paulo and from Babitonga Bay in Santa Catarina (Pinheiro and Cremer 2003, Oliveira and Monteiro-Filho 2006). Such seasonal pattern for these dolphin species is confirmed by local researchers' records and data from literature (Di Beneditto *et al.* 2001a, Santos *et al.* 2002, Siciliano *et al.* 2006, Souza *et al.* 2006) (Appendix 2).

4.5 Diet

Foraging activities of dolphins and whales are dynamic processes, which are easily perceived by fishers in the surroundings. As fisheries' specialists, it was easy for the interviewed fishers to identify which fish schools are being chased by dolphins. Another clue about dolphins' diet is obtained by fishers every time a dolphin is caught by a gillnet used to catch a specific fish. From these '*in loco*' observations, fishers provided a list including fishes, crustaceans and mollusks as

possible prey items for the cetaceans studied. Few from these cetaceans' species have been studied in Brazil in relation to feeding habits, except for *P. blainvillei*, *S. guianensis*, *Stenella longirostris* and *T. truncatus* (Di Beneditto *et al.* 2001a, Santos *et al.* 2002, Siciliano *et al.* 2004, Silva Jr. *et al*. 2004, Bassoi 2005). Data obtained from these researches about prey items for *P. blainvillei* and *S. guianensis* agree with some information given by the interviewed fishers (Appendix 2).

According to fishers' information, the main animals preyed on by whales are anchovy (*Anchoa* sp) and sardine (*Sardinella brasiliensis*), although most of the interviewed fishers confessed that they had not seen whales feeding in nature. However, a 'meme' was mentioned by most fishers: 'the elders used to tell that the whale stops near coastal rocks, open its mouth to let the anchovies in, then it swallows the fishes slowly, because whale's throat is very narrow'. It is possible that this 'meme' describes feeding habits of Bryde's whale, which occurs in tropical waters around the world and do not migrate to feed at polar latitudes (Siciliano *et al*. 2006). This whale have been observed feeding on schools of sardines near Alcatrazes Island, confirming partially the information on feeding behavior mentioned by the interviewed fishers (Siciliano *et al.* 2004).

Information on dolphins feeding behavior, provided by the fishers, were very detailed, including citations about feeding preferences, movements, chasing strategies and interactions with seabirds, confirming the great knowledge that the interviewees have on this topic.

In relation to the dolphins' species studied, the fishes more cited as prey were from the families Mugilidae, Engraulidae and Clupeidae, especially mullets ('tainhas' – *Mugil platanus* and 'paratis' – *Mugil curema*), anchovies ('manjuba' – *Anchoa* sp.) and sardine ('sardinha' – *Sardinella brasiliensis*). These fish species were also mentioned by fishers from Barra de São João and Armação dos Búzios (eastern coast of Rio de Janeiro), Cananéia, Babitonga Bay and Laguna as prey of *P. blainvillei*, *S. guianensis* and *T. truncatus* (Pinheiro and Cremer 2003, Peterson 2005, Hassel 2006, Oliveira and Monteiro-Filho 2006). Squids (Loliginidae) were also mentioned by our

interviewees as prey for *S. frontalis* and *T. truncatus*. According to Di Beneditto *et al*. (2001b), the analysis of stomach content of six *S. frontalis* showed that this species has a preference for squids as food item, what agrees with the interviewed citations. As opportunistic feeders, dolphins search for areas frequented by fish schools, so some dietary overlap among the dolphin species should be expected, however sympatric species of delphinids can choose different prey items as a result of different foraging efficiency or movement patterns (Di Beneditto *et al*. 2001b). The diet of the better known dolphins in the studied area (*S. guianensis*, *T. truncatus* and *P. blainvillei*) was also the better known by fishers. The concordance among fishers' citations and data from literature and local research was especially high for Bryde's whale and franciscana, marine tucuxi, Atlantic spotted and bottlenose dolphins (Appendix 2).

Some fishers (n=22) complained of the competition between them and dolphins for fish. A decade of studies on feeding behavior of *P. blainvillei* and *S. guianensis* carried out at the northern coast of Rio de Janeiro, found out that the main prey, among nearly 20 items, for *P. blainvillei* is: *Stellifer* sp. ('cangoá'), *Anchoa filifera* ('manjubinha'), *Pellona harroweri* ('piaba'), *Isospisthus parvipinnis* ('pescada-faneca'), *Cynoscion jamaicensis* ('goete'), *Chirocentrodon bleekerianus* ('peixe-vidro'), *Stellifer brasiliensis* ('canganguá') and *Sardinella brasiliensis* ('sardinha') and for *S. guianensis* is: *Trichiurus lepturus* ('peixe espada'), *Porichthys porosissimus* ('mamangá'), *Anchoa filifera* ('manjubinha'), *Paralonchurus brasiliensis* ('maria-luísa') and *Ariosoma opisthophthalma* ('congro') (Di Beneditto *et al.* 2001a). These authors also studied the fisheries at the northern coast of Rio de Janeiro state and found out that target species at the local fisheries are not the main prey for *P. blainvillei* and *S. guianensis.* These results confirmed that, at the northern coast of Rio de Janeiro, there is no intense competition by fish between these dolphins and fishers (Di Beneditto *et al.* 2001a). Similar research should be done at the studied area to investigate the intensity of competition for fish between fishers and dolphins.

4.6 Interactions with Fisheries

Interactions between cetaceans and fisheries have been studied for many species around the world. Cooperative fishing, a positive interaction, has been described involving *T. truncatus* and several fishing communities at Mauritania (western African coast) and Laguna (southern Brazilian coast) (Busnel 1973, Simões-Lopes *et al*. 1998, Peterson 2005). However, incidental capture by fishing nets, a negative interaction, is considered one of the major threatens to cetaceans around the world (Reeves *et al.* 2003).

Despite being one of the least cited topics, fishers' information on interactions between cetaceans and fisheries, when available, agreed with literature data, especially related to the most incidentally caught cetaceans' species (Appendix 2). It also agrees with information gathered by Di Beneditto *et al.* (2001a) for the northern coast of Rio de Janeiro, and with information given by fishers from Barra de São João, Armação dos Búzios, Cananéia, Paraná coast, Babitonga Bay and Laguna (Przbylski and Monteiro-Filho, 2001, Pinheiro and Cremer 2003, Peterson 2005, Hassel 2006, Oliveira and Monteiro-Filho 2006). Freitas-Netto (2003) described interactions among fishing gears and cetaceans in the coast of Espírito Santo State and among them are the interactions cited by interviewed fishers from São Sebastião (Figure 10B). In addition, local research data pointed out *P. blainvillei* and *S. guianensis* as the two most incidentally caught species in the surveyed area (Souza and Winck 2005), confirming fishers' citations.

Despite the confirmation of incidental capture by 75% of the interviewed fishers, we could notice that this topic is polemic among fishers, who avoided talking about it due to the governmental regulations prohibiting cetaceans' captures. Initially, when asked about this topic, most fishers denied it, changing their answers after a while, when they felt that the researcher's concern was

merely scientific. Fishers then provided detailed information about dolphins' behavior in relation to fishing nets, boats and fish schools.

4.7 Reproduction

Reproductive activities of cetaceans, such as mating and birth, are hardly seen at nature. This is a general situation for most of the aquatic animals, which may contribute to make reproduction of marine animals a topic lesser known by fishers. Silvano *et al*. (2006) found the same lack of information in their research on fishers' knowledge about the reproduction of 13 coastal fish species. Literature on cetaceans' reproduction is scarce, except for humpback and right whales, and franciscana and marine tucuxi dolphins (Clapham 2000, Di Beneditto *et al.* 2001b, Groch *et al.* 2005). However fishers' information about reproduction agreed to available literature and local research data for right whales, franciscana and marine tucuxi dolphins (Appendix 2).

Local fishers' knowledge on cetaceans' reproduction was related to the observation of mother-calf's pairs, their geographical localization and period of occcurrence. Because whales groups of mother-calf generally approach the coast they become very noticeable to the fishers, which find easier to recognize these groups than mother-calf pairs among a group of dolphins, which generally is more numerous than whales' groups. Despite their scarce knowlegde on this ecological aspect, most of the interviewees emphasized that 'whales are very careful with their calves, breast-feeding and protecting them against sharks'. Since neither of them has witnessed whales engaging in this behavior, it is probably a 'meme' transmitted through generations, which corresponds to true biological facts and reflects an anthropocentric interpretation by fishers. Connor *et al.* (2000) mentioned the behavior of vigilance and cooperative defense showed by bottlenose dolphin's mothers against sharks. Maybe this behavior could also occur among whales and their calves.

4.8 Predators

Predation on cetaceans is, generally, another situation hardly observed in nature. The general belief that 'whales and dolphins do not have predators' seems to be another 'meme', because nearly 80% of fishers repeated it. The size, inteligence, strength and swimming abilities of these animals were mentioned as the main causes because no predator attacks them.

A minority of fishers blamed sharks and one of them mentioned killer whales as possible predators, based in scars observed on dead dolphins. This was confirmed by scientific literature, which describes the effects of predation by sharks and killer whales on cetaceans. For example, Clapham (2000) cited killer whales as the main predator on humpback whales and Connor *et al.* (2000) discussed the predation on bottlenose dolphins by sharks of the species *Carcharinus leucas, C. obscurus, Carcharodon carcharias* and *Galeocerdo cuvieri*. In addition, some fishers quoted man, through fishing nets, as one of the possible predators of cetaceans, which reflects their awareness in relation to the threat represented by gillnets.

5. Conclusions

The high concordance among the local ecological knowledge of the fishers from São Sebastião, the knowledge of fishers from other communities of southern and southeastern Brazil, data obtained by local researchers and from literature is remarkable. This concordance indicates a similar perception of biological patterns by fishers from diverse geographical areas and cultures if we consider that fishers from the southern Brazilian coast have received different cultural influences when compared to fishers from southeastern coast. Even considering the least cited topics, fishers' knowledge corroborated some of local research data about cetaceans' ecology. However, regarding marine organisms, there are some biological aspects that are not easily accessed, even through

scientific research. That is the case of cetaceans' reproduction, which, for most of the species, is very difficult to observe in nature. The same was verified in relation to fish reproduction by Silvano *et al.* (2006) in their study about fishers' knowledge regarding migration and reproduction of Brazilian coastal fishes. They found a lack of fishers' knowledge about the reproduction patterns of some pelagic fish species and related this fact to the difficulty of observation (Silvano *et al.* 2006).

Cetaceans are a group of aquatic mammals that have many species so scarcely known that they can not even be evaluated in terms of conservation status. All available piece of information about them is important in order to improve their chances of conservation.

Our results indicated how dynamic is local fishers' knowledge, due to the citation of many 'memes' learnt from the elders, as well as the absorption by fishers of information about humpback and killer whales from TV programs. Even considering the least mentioned topics or species, we believe that the data obtained from fishers about cetaceans' ecology can contribute to future researches to supply this lack of information by pointing out new lines of investigation. Accurate information on ecological aspects is essential to define conservation areas for the cetacean's species, especially for those that are endangered of extinction. Fishers' ecological knowledge can be a useful tool determining the fishing grounds where accidental capture of cetaceans are more critical in the studied areas as well as indicating possible changes in gillnets operations in order to reduce cetaceans catches. Drew (2005) suggests that local ecological knowledge can be applied to studies on behavioral ecology and population-level biology. Fishers' contribution to obtain information in these areas of study can be as valuable as their contribution regarding the management of local conservation areas. Besides, their participation in such researches can be a way to revive and valorize their local culture.

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Figures

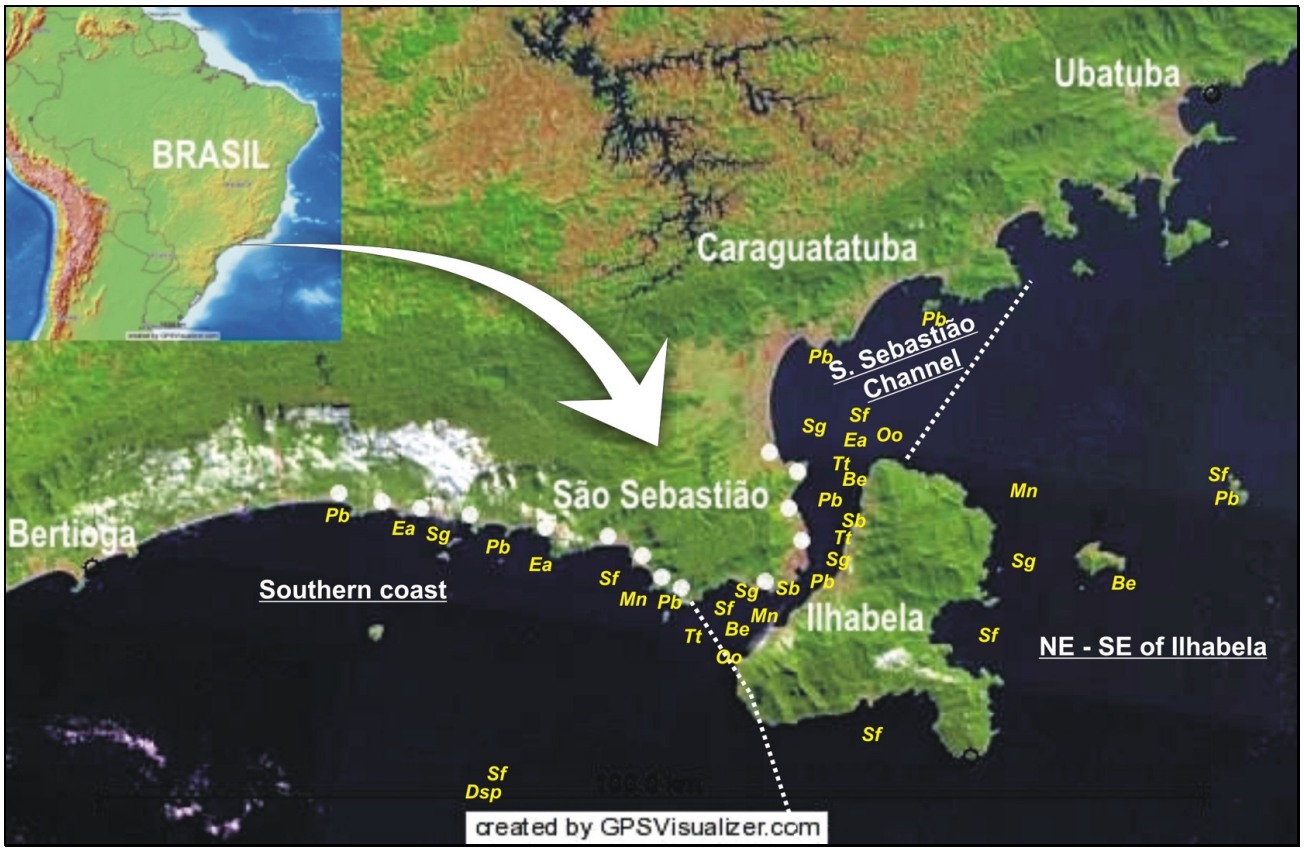


Figure 1. Northern coast of São Paulo State, showing fishing communities studied (white points) at São Sebastião. Letters represent the occurrence areas of cetaceans' species, plotted in the 3 arbitrary major areas (underlined), in which fishers' citations were coincident with local research records (data from 'Projeto SOS Mamíferos Marinhos'). (Ea – right whale, Be – Bryde's whale, MN – humpback whale, Oo – killer whale, Tt – bottlenose dolphin, Sb – rough-toothed dolphin, Dsp – common dolphin, Sf – Atlantic spotted dolphin, Sg – marine tucuxi, Pb – franciscana dolphin).

Figure 2. Artisanal fishers from São Francisco beach (São Sebastião) repairing a gillnet.

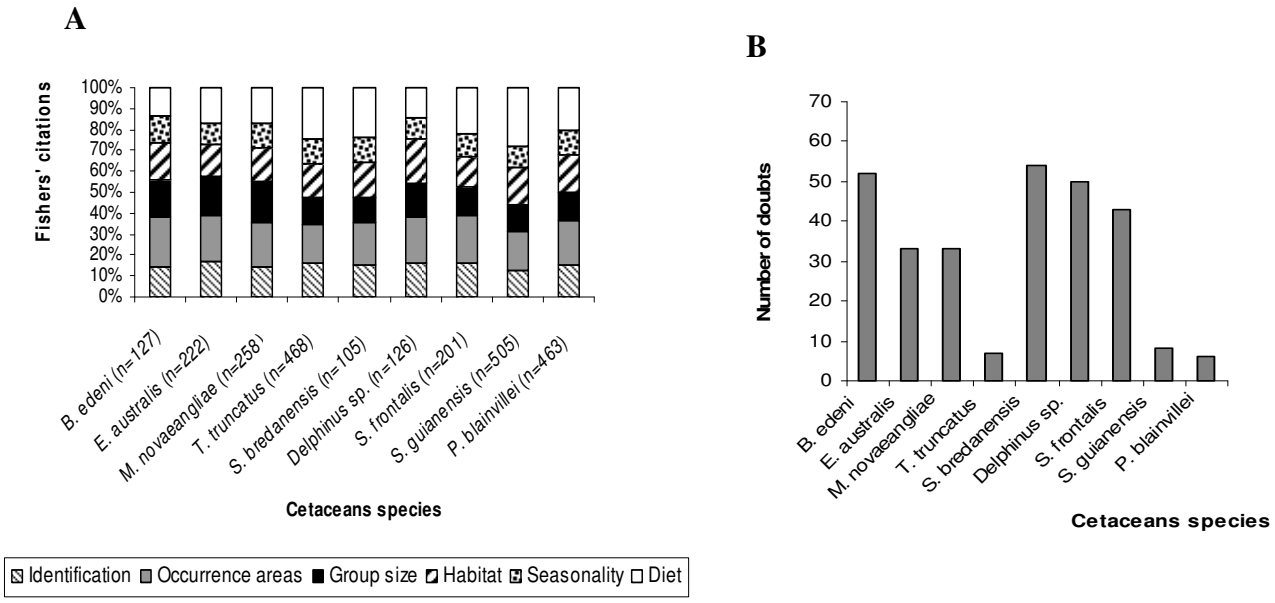


Figure 3. A – Proportion of fishers citations for 6 ecological aspects of 9 species of cetaceans. B - Fishers' doubts about the surveyed species.

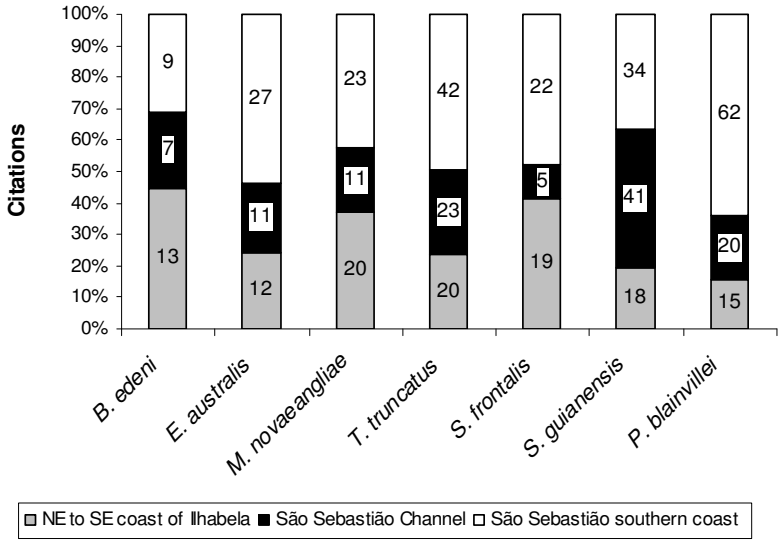


Figure 4. Cetaceans' distribution in three major areas of northern coast of São Paulo, according fishers from São Sebastião (number of citations inside de bars).

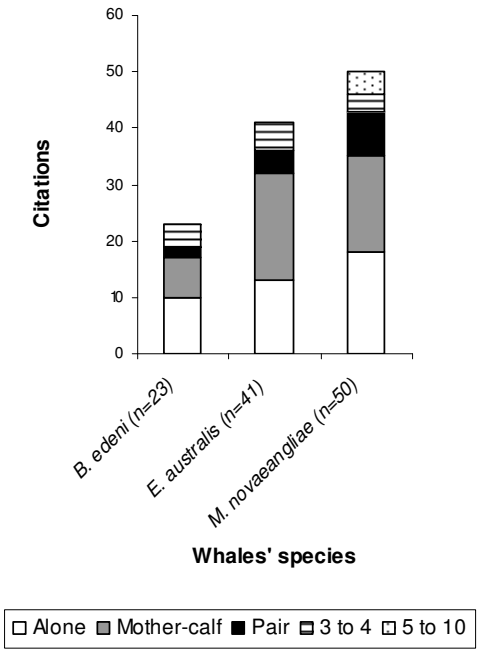


Figure 5. Most mentioned group sizes for whales' species, according to fishers' citations (n= number of positive citations/species).

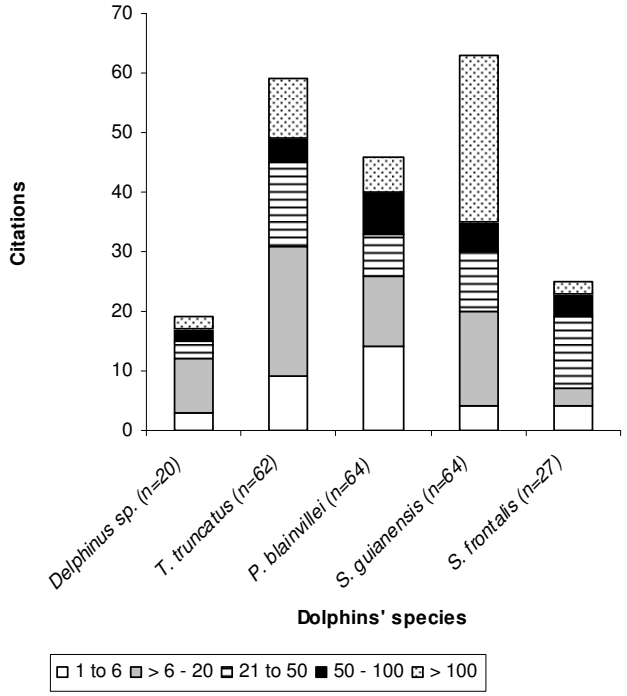


Figure 6. Most mentioned group sizes for dolphins' species, according to fishers' citations (n= number of positive citations/species).

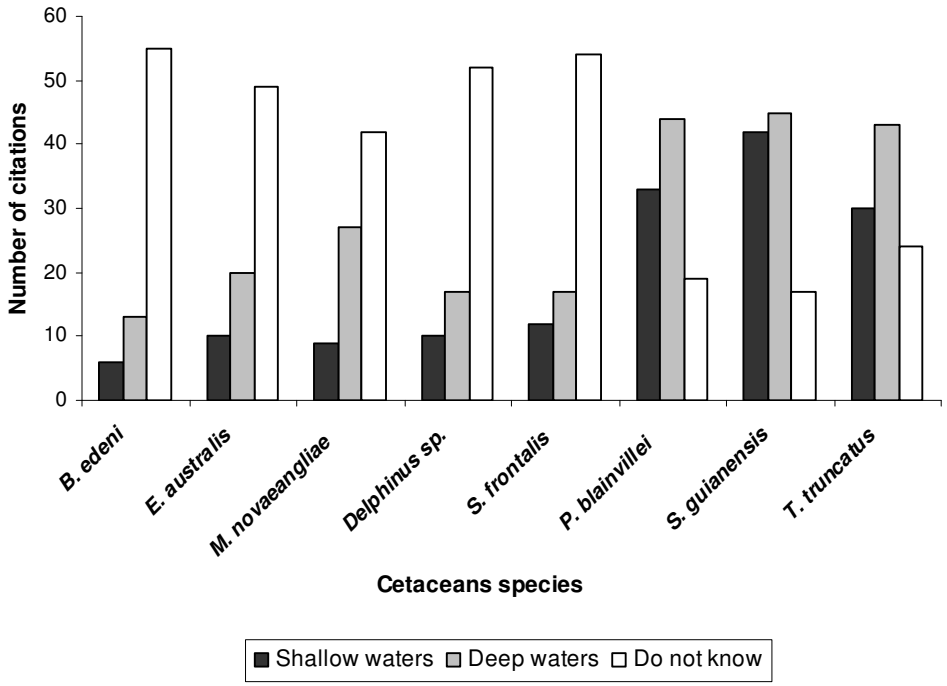


Figure 7. Information about cetaceans' habitats obtained from fishers from São Sebastião.

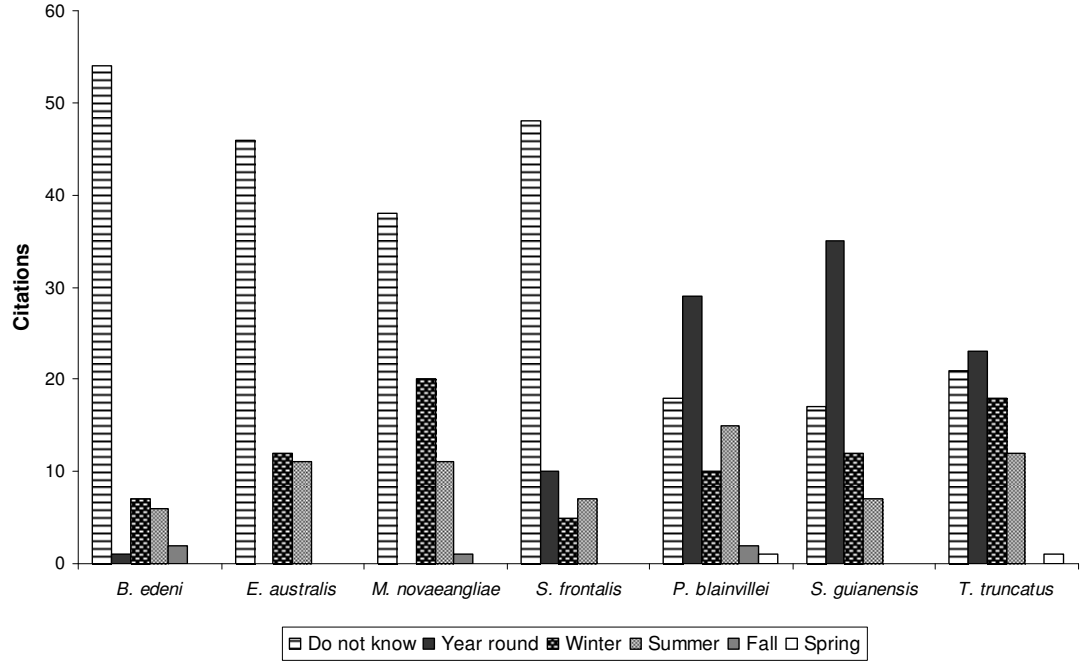


Figure 8. Seasonal patterns of cetaceans occurrence, according to fishers' citations.

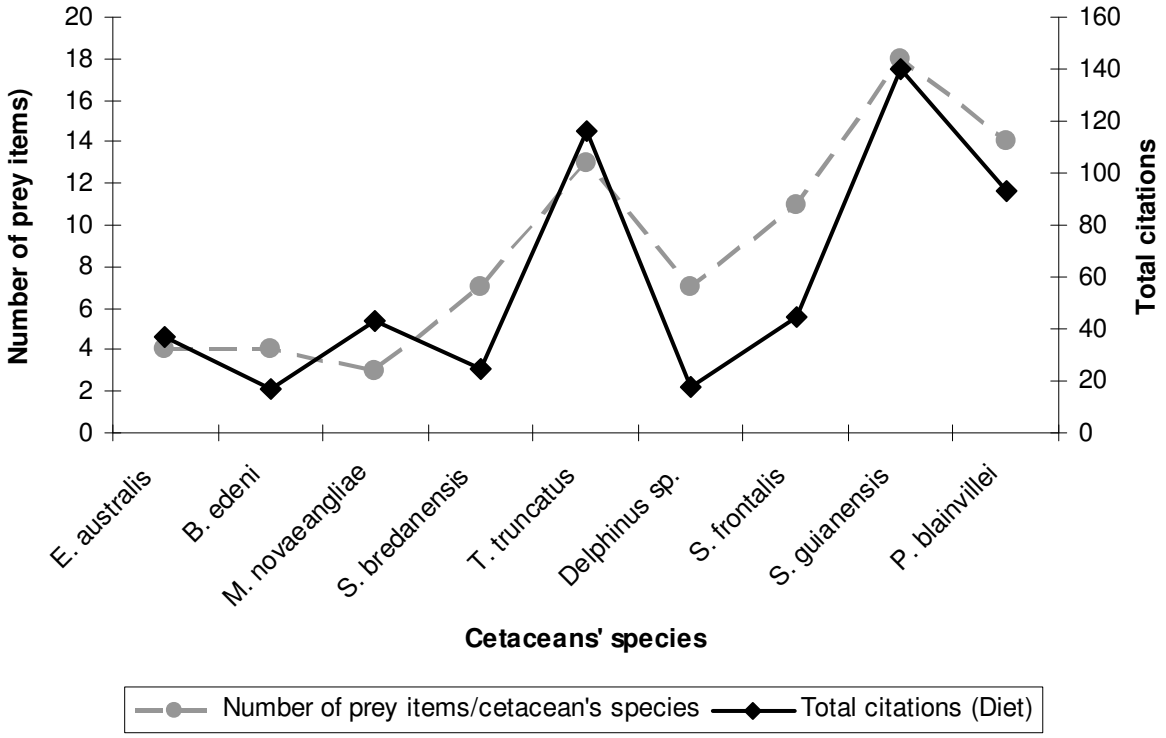
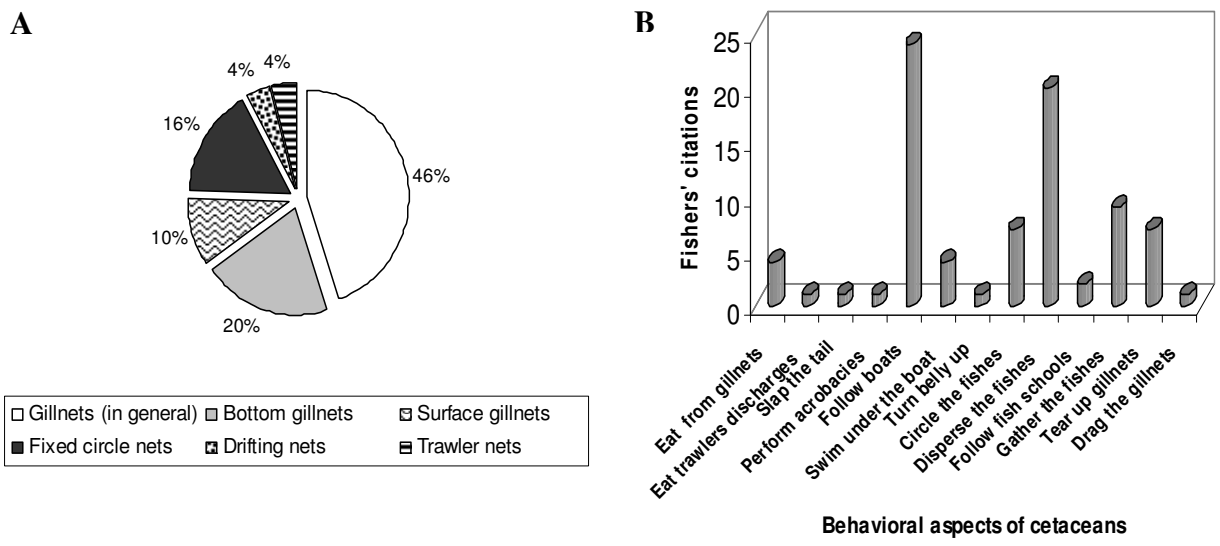


Figure 9. Fishers' citations regarding to the diet of the studied cetaceans' species. A list of prey items is provided in Table 2.



Figures 10. A- Fishing nets mentioned by fishers to be related to cetaceans' incidental captures (% of citations for n=49), B- Behavioral aspects of cetaceans observed by the interviewees during their fishing activities (number of citations).

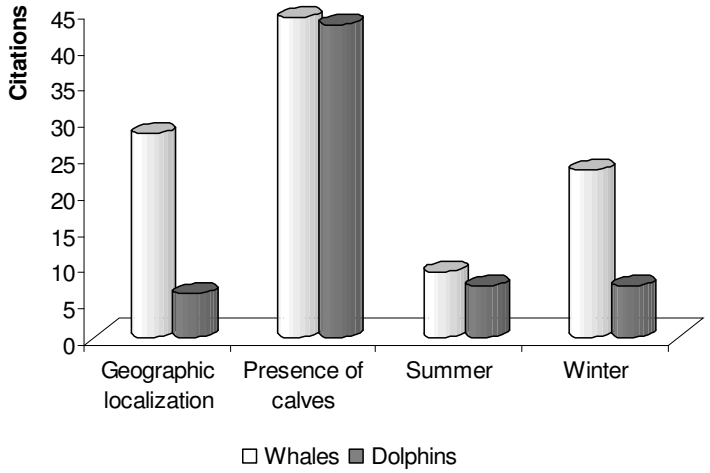


Figure 11. Fishers' citations for each aspect of cetaceans' reproduction (season, presence and geographic localization of mother-calf sightings). Detailed information regarding each cetacean's species reproduction is in the Appendix 3.

Tables

Table 1. Distribution of cetaceans according to fishers' citations (more quoted places are in italic).

Occurrence areas	*E. australis*	*B. edeni*	*M. novaeangliae*	*S. bredanensis*	*T. truncatus*	*Delphinus sp.*	*S. frontalis*	*S. guianensis*	*P. blainvillei*	Total Citations
NE/SE of Ilhabela Island										
Ubatuba		1			1					2
Anchieta Island						1				1
Búzios Island	1	3	3		3	2	3		1	16
Vitória Island		1	1		3		1			6
Tamanduá Island			1					1		2
NE/SE coast of Ilhabela Island	*2*	*1*	*5*	*2*	*9*	*2*	*4*	*7*	*7*	39
Jabaquara (Ilhabela)			2	1	1	2	2	2	1	11
Praias Poço - Fome (Ilhabela)	2	1	2	1		1	1	2		10
Serraria (Ilhabela)	1						1	1	2	5
Saco do Eustáquio (Ilhabela)	1	1					1			3
Castelhanos (Ilhabela)	2	3	3	1	1	3	1	1	1	16
Pta. Grossa (Ilhabela)		1	1			1	1	2	1	7
Pta do Boi (Ilhabela)	1				1					2
Saco da Pirabura (Ilhabela)	1	1	1		1		1			5
Pta Sepituba, Pta Sela (Ilhabela)			2	1			1	1	1	6
Indo para o Bonete / Bonete (Ilhabela)	1	1		2		1	2	2	1	10
Total Area 1	12	14	21	8	20	13	19	19	15	141
São Sebastião Channel										
Pta. das Canas (Ilhabela)	1							1		2
Enseada	1	2			2	1		17	7	30
Pta. Do Arpoar				1	3			1		5
S. Sebastião Channel	*6*	*3*	*5*	*4*	*14*	*2*	*5*	*17*	*7*	*63*
São Francisco								2	3	5
Barequeçaba	1		1		2				1	5

Guaecá	2	1	4		2			2	2	13
Curral (Ilhabela)		1								1
Total Area 2	11	7	10	5	23	3	5	40	20	124
Southern coast										
Toque-Toque Grande Island			1		1			3	7	12
Toque-Toque	1	1	5	1	9	1	1	6	12	37
Toque-Toque Pequeno (out of Apara reef)	1				1	1			2	5
Santiago								1	1	2
Paúba	2		1		1			1	4	9
Maresias	1				2	1		2	4	10
Boiçucanga	3	4		2	5		1	2	8	25
Baleia	1									1
Barra do Sahy	1				2			1	2	6
Juqueí	2		1		1			1	1	6
Barra do Una			2		2			2	1	7
Gatos Island	3									3
Couves Island		1	2			2	1	1	2	9
Islands of southern coast (in general)					2	2	4	1	4	13
Montão de Trigo Island	2	1	1				1	1	1	7
Alcatrazes Island	1		1	2	5	4	3		2	18
Beaches of the southern coast (in general)	*5*		*8*	*2*	*5*	*1*	*5*	*10*	*9*	*45*
Boracéia	2				1		3	2	1	9
Bertioga	1	1		1	1				1	5
60 nm off the coast, offshore		1	1		3		3			8
Guarujá	1									1
From Santos to Alcatrazes					1					1
Total Area 3	27	9	23	8	42	12	22	34	62	239
Total Citations	50	30	54	21	85	28	46	93	97	504

Table 2. Prey items consumed by cetaceans at São Sebastião, according to interviewed fishers. (Species identification followed Ávila-da-Silva (2005) and Fishbase (Froese and Pauly 2007)

Biological family	Biological species	English common names	Folk names	Citations
Clupeidae	*Sardinella brasiliensis*	Sardine	Sardinha	67

	Brevoortia pectinata	Menhaden	Savelha	4
Engraulidae	*Anchoa* sp.	Anchovy	Manjuba	73
Hemiramphidae	*Hyporhamphus* sp.	Halfbeak	Panaguaiú	10
Belonidae	*Tylosurus acus*	Needlefish	Timbale	1
Serranidae	*Epinephelus marginatus*	Grouper	Garoupa	1
Pomatomidae	*Pomatomus saltatrix*	Bluefish	Enchova	5
Carangidae	*Caranx* sp.	Jack	Xaréu	2
	Oligoplites sp.	Leatherjack	Guaivira	3
	Selene sp.	Moonfish	Peixe-Galo	1
	Caranx crysos	Blue runner	Carapau	3
Sciaenidae	*Cynoscion* sp.	Shortfin corvina	Pescadinha	5
	Micropogonias furnieri	Croaker	Corvina	1
	Paralonchurus brasiliensis	Banded-croaker	Maria-Luíza	1
	Menticirrhus sp.	Kingcroaker	Betara	1
	Larimus breviceps	Drum	Oveva	2
Mugilidae	*Mugil platanus*	Mullet	Tainha	125
	Mugil curema	White mullet	Parati	47
Sphyraenidae	*Sphyraena* sp.	Barracuda	Bicuda	1
Trichiuridae	*Trichiurus lepturus*	Cutlassfish	Espada	4
Scombridae	*Scomberomorus brasiliensis*	Mackerel	Sororoca	2
Stromateidae	*Peprilus paru*	Butterfish	Gordinho	1
Carcharhinidae	*Carcharhinus* sp.	Shark	Cação	1
Loliginidae	*Loligo* sp.	Squid	Lula	35
Argonautidae	*Argonauta argonauta*	Argonauta	Argonauta	1
Penaeidae	*Xiphopenaeus kroyeri, Litopenaeus schimitti*	Shrimp	Camarão	5
Total citations				402

Appendix 1

Questionnaire about cetaceans' Ethnoecology (questions asked when showing plates of 11 cetaceans' species)

1-	Are whales and dolphins fish? If yes / no, why?
2-	Do you know this animal? How do you call it?
3-	Where have you seen this animal?
4-	When do you see this animal (season or month)?
5-	What does this animal feed on?
6-	Where does it live?
7-	Does it move alone or in group? Groups of how many animals?
8-	Have you seen calves in the groups? In what season / month?
9-	What animal could attack this animal?
10-	In your opinion, how is the interaction between this animal and fisheries activities?
11-	Do you think these animals (whales/dolphins) could be grouped? How? Why?
12-	Have you ever learned a story or tale about these animals? Who did tell you? Do you believe it?

Appendix 2

Comparisons of fishers' knowledge with data from local research and from the scientific literature (concordant data between scientific sources and fishers' information are written in bold). Numbers of fishers' citations for each ecological aspect are in the Appendix 2.

Species/Topics	Fishers Ecological Local Knowlegde	Local Scientific Research - *Projeto SOS Mamíferos Marinhos* (data from sighted (S), stranded dead (D) or captured (C) animals - northern coast of São Paulo)	Scientific literature: ecological aspects of cetaceans for the southeastern Brazil (emphasis for São Paulo coast).
E. australis (Balaenidae)			(Lodi et al. 1996, Santos *et al*. 2001, Siciliano *et al.* 2006)
Occurrence areas	**S. Sebastião Channel** **Boiçucanga** Gatos Island	**Enseada (S)** **Boiçucanga (S) and Maresias (S, D)** Southern of Ilhabela (S)	**São Sebastião Channel** Southeastern Brazil Cananéia, Peruíbe, Itanhaém, Santos, Ubatuba (São Paulo coast)
Group size	**S. Sebastião southern coast** **mother-calf** **alone**	**Barra do Una (S)** **mother-calf** **Alone**	**Maresias (São Sebastião)** **mother-calf** 2 to 12
Habitat	deep waters	shallow waters	shallow waters
Seasonality	summer* **winter***	October **July, August, September**	January, October, November, December **July, August, September,** October
Prey (main items)	manjuba (anchovy), sardinha (sardine)	no records	crustaceans
Reproduction (presence of calves, season, site)	**calves** **winter** **Boiçucanga** NE to SE of Ilhabela and surrounding islands	**3 groups of mother-calf sighted** **August,** September, October **Boiçucanga,** B. do Una, southern of Ilhabela	**strandings of 5 dead calves, sightings of mother-calf** **July, August, September**, October, November, December São Sebastião Channel, Maresias **São Paulo** and Rio de Janeiro **coast**
Interactions with fishing activities	no citations	no records	Ubatuba, 1 animal swimming with a nylon rope attached to it 1 animal swimming with part of a gillnet attached to its head (Rio de Janeiro coast)

B. edeni (Balaenopteridae)			(Hetzel and Lodi 1993, Zerbini *et al.* 1997, Siciliano *et al.* 2004, Siciliano et al. 2006)
Occurrence areas	Boiçucanga	Alcatrazes Archipelago (S)	Southeastern Brazil
	Castelhanos		Alcatrazes Island
	Búzios Island	Toque-Toque Pequeno (D)	**Búzios Island**
	S. Sebastião Channel	**Ponta das Canas (D) and Araçá (D)**	
Group size	**alone**	**Alone**	**alone**
	mother-calf	2 to 6	2 until 20 animals
Habitat	**deep waters**	30 - 45 m	**deep** and shallow **waters**
Seasonality	**winter**	March, April	April, May, June, **July, August, September**
	summer	October	November, **December, January, February**
Prey (main items)	**sardinha (sardine), manjuba (anchovy)**	**sardinha (sardine),** enchova (Bluefish)	**Sardinella brasiliensis,** Carangidae, Clupeidae, Engraulidae and planktonic crustaceans
Reproduction (presence of calves, season, site)	calves	no records	
	winter		
	Boiçucanga		
Interactions with fishing activities	**cerco fixo (fixed circle net)**	**1 stranded animal showing marks of fishing net**	
M. novaeangliae (Balaenopteridae)			(Hetzel and Lodi 1993, Siciliano 1997, Zerbini *et al.* 2004, Siciliano *et al*. 2006)
Occurrence areas	**S. Sebastião southern coast**	**Maresias (S)**	Southeastern Brazil
	NE to SE of Ilhabela and surrounding islands	**Pacuíba (S), Pta. da Sela (S)**	**Búzios Island**
	S. Sebastião Channel	**Barra Velha (D), Cigarras (D), Pitangueiras (D), S. Sebastião Channel (S)**	
	Toque-Toque	**Toque-Toque Grande (D)**	
Group size	**alone**	**Alone**	**alone**
	mother-calf		**mother-calf**, groups until 20 animals
Habitat	**deep waters**	shallow waters	**deep** and shallow **waters**
Seasonality	**winter**	**July, August,** October, November, December	December

Prey (main items)	**manjuba (anchovy), sardinha (sardine)**	no records	krill, **small fishes**
Reproduction (presence of calves, season, site)	calves winter off Ilhabela	no records	
Interactions with fishing activities	no citations	no records	calf caught in gillnet (Ubatuba - October), 7 animals caught by gillnets in the coasts of Rio de Janeiro, São Paulo and Espírito Santo
O. orca (Delphinidae)			(Hetzel and Lodi 1993, Siciliano *et al.* 1999, Siciliano *et al.* 2006)
Occurrence areas	**S. Sebastião Channel** **NE to SE of Ilhabela and surrounding islands**	**Ponta das Canas, Barra Velha, Curral, Cigarras** 47 nm off Ilhabela	São Paulo and Rio de Janeiro coasts **Vitória Island**
Group size	**alone** **2 to 6**	**Alone** 6 to 10	**alone** **3 animals,** 1 to 15 animals
Habitat	deep and **shallow waters**	deep and **shallow waters**	**shallow waters**
Seasonality	**winter*** **summer****	April, **July** October, November, December	**June, July** spring* and **summer**
Prey (main items)	sardinha (sardine), manjuba (anchovy)	no records	
Reproduction (presence of calves, season, site)	no citations	1 group of mother-calf sighted, November, Curral (Ilhabela) November	
Interactions with fishing activities	no citations	no records	
S. bredanensis (Delphinidae)			(Hetzel and Lodi 1993, Santos 1999, Di Beneditto et al. 2001, Siciliano et al. 2006)
Occurrence areas	**S. Sebastião Channel**	**Armação (S), Praia da Vila (S), Pier da Petrobras (S), Praia Grande (D), Araçá (D), Porto Grande (D), São Francisco (D), Enseada (D),** Poço (S), Fome (S), Alcatrazes Island(S)	Comprida Island (São Paulo coast), Grande Island, Ponta da Juatinga, Arraial do Cabo (Rio de Janeiro coast)
Group size	**31 to 50** **11 to 20**	6 to 10	**groups of 10, 20 until 50 animals**
Habitat	**deep waters**	shallow waters	**deep** and shallow **waters**
Seasonality	winter		May, September, October

	year round	**February, March, June, July, August, September, November, December**	
Prey (main items)	tainha (mullet), sardinha (Sardinella)	squids, Trichiuridae	
Reproduction (presence of calves, season, site)	no citation	no records	
Interaction with fishing activities	no citation	no records	5 animals caught in gillnets in the northern coast of Rio de Janeiro
Delphinus sp. (Delphinidae)			(Hetzel and Lodi 1993, Santos 1999, Di Beneditto et al. 2001, Santos *et al. 2002, Siciliano et al.* 2006)
Occurrence areas	**Alcatrazes Archipelago** Castelhanos	**Alcatrazes Island (S)** Montão de Trigo Island (S), offshore waters (C)	Southeastern Brazil Comprida Island, Marujá (São Paulo coastal waters)
Group size	6 to 10 **11 to 20**	30 **10 to 15**	**few animals** to hundreds
Habitat	**deep and shallow waters**	**shallow waters**	**deep and shallow waters**
Seasonality	summer winter	October, November	May, June, July, August, September, October
Prey (main items)	tainha (mullet)	no records	fishes (Trichiuridae), squids
Reproduction (presence of calves, season, site)	no citation	2 groups of mother-calf sighted, November, Alcatrazes	
Interaction with fishing activities	no citation	2 animals captured by trawler nets	**2 animals caught in gillnets** in the northern coast of Rio de Janeiro
T. truncatus (Delphinidae)			(Hetzel and Lodi 1993, Santos 1999, Di Beneditto et al. 2001, Santos *et al.* 2002, Siciliano *et al.* 2006)
Occurrence areas	**S. Sebastião Channel** NE to SE of Ilhabela and surrounding islands	**Pequeá (D), Portinho (D), Cabras Island (S and D), Guaecá (D), Barequeçaba (D), Pitangueiras (D), Praia Grande (S and D), Araçá (D), Porto (D), Porto Grande (D), Abricó (D), Enseada (D)** Alcatrazes Archipelago (S)	Rio de Janeiro coast, Comprida Island, Marujá (São Paulo coast)
Group size	**Toque-Toque** S. Sebastião southern coast 11 to 20	**Toque-Toque Pequeno**	

	31 to 50 **more than 100**	**20 to 40** **more than 100**	**20 to 50, hundreds**
Habitat	deep and **shallow waters**	**shallow waters**	deep and **shallow waters**
Seasonality	**year round** winter*	**February, March, April, May, June, july, August, September, December**	**February, March, May, June, August, September, November, December**
Prey (main items)	**tainha (mullet)**, parati (mullet)	fishes (**mullets**)	fishes (Trichiuridae), squids, octopus
Reproduction (presence of calves, season, site)	**calves**	**1 group with calves, March, Alcatrazes**	
Interaction with fishing activities	**caught by gillnets, follow the boats,** harass the fishes	**1 animal caught by gillnets, follow the boat**	**6 animals caught in gillnets** in the northern coast of Rio de Janeiro
S. frontalis (Delphinidae)			(Hetzel and Lodi 1993, Di Beneditto et al. 2001, Moreno *et al.* 2005, Siciliano *et al.* 2006)
Occurrence areas	**S. Sebastião Channel** **S. Sebastião southern coast** **Southern coast islands** **NE to SE of Ilhabela and surrounding islands**	**Praia Grande (D), Cabelo Gordo (D), Porto (D), Enseada (D), Itaguaçú (D), Pta. da Sela (S), Pta. das Canas (S)** **Maresias (D)** **Alcatrazes Archipelago (S)** **Bonete (S), Sombrio (S), Vitória Island (S), 47 nm offshore**	Rio de Janeiro and São Paulo coasts
Group size	31 to 50 **2 to 6** **21 to 30** **50 to 100**	10, 12 **4 to 6** **30** **50 to 60, 100**	**2 to 200 (most groups < 50)**
Habitat	deep and **shallow waters**	**shallow waters**	**shallow waters**
Seasonality	**year round** summer**	**February, March, April, May, July, August, September, October, December**	
Prey (main items)	tainha (mullet), parati (mullet), **squid**	**squids** and fishes from the families: Haemulidae, Triglidae, Myctophidae	fishes (weakfish, croaker, cutlassfish), **squids**
Reproduction (presence of calves, season, site)	**calves**	**3 groups of mother-calf, August - Vitória Island and Bonete, May – Sombrio**	

Interaction with fishing activities	**follow the boats**	**follow the boat,** 2 animals caught by gillnets	7 animals caught in gillnets in the northern coast of Rio de Janeiro
S. guianensis (Delphinidae)			(Di Beneditto et al. 2001, Di Beneditto and Ramos 2001, Santos *et al*. 2002, Siciliano *et al*. 2006, Souza *et al.* 2006)
Occurrence areas	**S. Sebastião Channel**	**Kaufman (D - S), Cigarras (D and S), S. Francisco (D), Arrastão (D), Pontal da Cruz (D), Porto Grande (D - S), Porto (D), Segredo (D), Barequeçaba (D), Pequeá (D), Perequê (D), Portinho (D)**	Comprida Island, Marujá, **Enseada de Caraguatatuba, Ilhabela** (São Paulo coast)
	Enseada	**Enseada (D - S),** Massaguaçú (D), Martim de Sá (D), Capricórnio (D), Indaiá(D), Tamanduá Island (S)	northern coast of Rio de Janeiro (Atafona, Macaé)
	S. Sebastião southern coast	**Barra do Una (D), Camburizinho (D)**	Eastern coasts of Rio de Janeiro (Arraial do Cabo)
	NE to SE of Ilhabela and surrounding islands	**Saco do Eustáquio (S), Serraria (S)**	
Group size	**more than 100**	30 to 50	**Hundreds**
	11 to 20	4 to 7, **10, 12, 15, 20**	**10 to 15**
Habitat	deep and **shallow waters**	**shallow waters**	**shallow waters**
Seasonality	**year round**	**January, February, March, April, May, June, July, August, September, October, November, December**	**year round**
	winter		
Prey (main items)	**tainha (mullet), parati (mullet)**	squids and fishes from the families: Sciaenidae, Myctophidae, Engraulidae, Batrachoididae	Sciaenide, Haemulidae, Gerreidae, Paralichtidae, Batracoididae, Trichiuridae, Engraulidae, **Mugilidae,** squids and shrimps
Reproduction (presence of calves, season, site)	**calves**	**12 groups mother-calf, Porto Grande, Enseada , Tamanduá Island**	**presence of calves** at the northern coast of Rio de Janeiro
	winter	January, April, May, **July, August,** December	year round
Interaction with fishing activities	**caught by gillnets, follow the boats, harass the fishes**	**6 animals caught by gillnets**	**142 animals caught in gillnets** in the northern coast of Rio de Janeiro
P. blainvillei (Pontoporiidae)			(Di Beneditto et al. 2001, Di Beneditto and Ramos 2001, Santos *et al*. 2002)
Occurrence areas	**S. Sebastião southern coast**	**Boracéia (D), Cambury (D), Barra do Sahy (C), Maresias (D)**	Coast of São Paulo (Ilha do Cardoso, Ilha Comprida, Peruíbe, Itanhaém, Mongaguá, Praia Grande, Santos, São Vicente, Guarujá, Bertioga, **São Sebastião,** Caraguatatuba, **Ilhabela**, Ubatuba)
	Boiçucanga		northern coast of Rio de Janeiro (Atafona, Macaé)
	Toque-Toque Island	**Toque-Toque Pequeno (C)**	
	Enseada		

	NE to SE of Ilhabela and surrounding islands	**Vitória Island (C)**	
	S. Sebastião Channel	**Guaecá (D), Barequeçaba (D), Segredo (D), Cabelo Gordo (D), Praia Grande (D), Porto (D), Porto Grande (D), Arrastão (D), São Francisco (D), Camaroeiro (C), Tamanduá Island (C), Pta. das Canas (D), Saco Grande (D), Itaquanduba (D), Engenho d´água (D), I. das Cabras (D), Portinho (D), Feiticeira (D)**	
Group size	Pair **6 to 14**	no records	**1 to 15**
Habitat	deep or **shallow waters**		**shallow waters**
Seasonality	**year round** summer	**January, February, March, May, June, July, August, September, October, November, December**	**year round**
Prey (main items)	**manjuba (anchovy), sardinha (sardine),** tainha (mullet)	squids and fishes from the families: Sciaenidae, Ariidae, **Clupeidae, Engraulidae**	*Stellifer sp.,* ***Anchoa filifera,*** *Pellona harroweri, Isopisthus parvipinnis, Cynoscion jamaicensis, Chirocentrodon bleekerianus, Stellifer brasiliensis,* ***Sardinella brasiliensis,*** squids from the family Loliginidae (*Loligo plei, L, sanpaulensis, Lolliguncula brevis*)
Reproduction (presence of calves, season, site)	**calves** winter	**10 calves (TL < 90 cm) stranded or captured by gillnets**	**presence of calves** at the northern coast of Rio de Janeiro year round
Interaction with fishing activities	**caught by gillnet**	**15 animals accidentally captured by gillnets**	**181 animals caught in gillnets** in the northern coast of Rio de Janeiro

Note: * winter (july to september), spring (october to december), summer (january to march) and fall (april to june) for the southern hemisphere

Appendix 3

A. Fishers' citations for ecological aspects related to each studied cetacean's species.

Ecological Aspects	*E. australis*	*B. edeni*	*M. novaeangliae*	*S. bredanensis*	*T. truncatus*	*Delphinus* sp.	*S. frontalis*	*S. guianensis*	*P. blainvillei*	χ^2 **(*p*)**	General citations (whales + dolphins)	**Total citations / topic**
Occurrence areas	50	30	54	21	85	28	46	93	97			504
Group size	41	23	50	13	62	20	27	64	64			364
Habitat	33	23	41	18	75	27	29	88	80			414
Seasonality	24	16	32	12	54	13	22	54	57			284
Diet	37	17	43	25	116	18	45	140	93			534
Reproduction	39	20	44	0	9	1	4	22	24			163
Interaction with fisheries	2	5	7	2	20	2	9	35	65	243 (<0.0001)	73	220
Predators											66	66
Total citations / species	226	134	271	91	421	109	182	496	480			2549

Ho: citations for each ecological aspect are not dependent on the cetacean's species to which they refer. *P* value is significant, Ho is rejected.

B. Citations representing the number of doubts ('do not know' answers) for ecological aspects of the cetaceans, according to interviewed fishers.

Cetaceans species	**Occurrence areas**	**Group size**	**Habitat**	**Seasonality**	**Diet**	**Reproduction**	**Interacions with Fisheries**	χ^2	***p***
E. australis	33	33	49	46	43	53	68		
B. edeni	52	53	55	54	56	62	65		
M. novaeangliae	36	36	42	38	41	51	64		
S. bredanensis	54	57	58	58	58	70	68		
T. truncatus	9	19	24	21	14	64	54		
Delphinus sp.	50	55	52	57	59	69	68		
S. frontalis	43	44	54	48	49	66	63		
S. guianensis	10	13	17	17	13	54	42		
P. blainvillei	8	14	19	18	19	55	16	137	<0.0001

Ho: the number of doubts (DNK answers) is not dependent on the cetacean's species to which it refers. *P* value is significant, Ho is rejected.

Appendix 4

Summarized list of the main ‘memes’ mentioned by fishers from São Sebastião regarding cetaceans.

	Number of fishers who spontaneously mentioned the ‘meme’
1. 'Whales and dolphins are just passing from one place to another'.	7
2. 'Whales and dolphins do not have any preference for some place. They only care about food. They just go behind their food'.	5
3. 'Whales approach the coast when they are breeding their calves. In this manner they protect their calves from the sharks'.	3
4. 'Dolphins appear following schools of mullet'.	5
5. 'Dolphins are walkers, they never stop around'.	3
6. 'Whales and dolphins live at deep waters’	45
7. 'The whale stops near coastal rocks, open its mouth to let the anchovies in, then it swallows the fishes slowly, because whale’s throat is very narrow'.	17
8. ‘Whales are very careful with their calves, breast-feeding and protecting them against sharks’	4
9. 'Dolphins swallow the fish head first'.	5
10. 'Dolphins do not eat rocky fishes because they have a lot of spines'.	3
11. 'Whales and dolphins do not have predators'.	56
12. 'Dolphins help people who are drowning at sea or shipwrecked people'.	5
13.'The left eye of the dolphin, after collected, dried and blessed by a faith healer, can be used to attract woman'.	5

Capítulo 4

ETHNOBIOLOGY OF *SOTALIA GUIANENSIS* (CETACEA: DELPHINIDAE) IN THE NORTHERN COAST OF SÃO PAULO STATE, BRAZIL

Botos-cinza (*Sotalia guianensis)* avistados em Janeiro de 2003, na praia de Massaguaçú, Caraguatatuba, São Paulo, Brasil.

Capítulo 4 – Ethnobiology of *Sotalia guianensis* (Cetacea: Delphinidae) in the Northern coast of São Paulo State, Brazil

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Abstract

The frequent occurrence of *Sotalia guianensis* (marine tucuxi) in the northern coast of São Paulo State (Caraguatatuba, São Sebastião and Ilhabela) has been confirmed through records of sightings and stranded or accidentally captured animals, along the last 12 years of monitoring by *"Projeto SOS Mamíferos Marinhos"*. Local fishers have also related the presence of marine tucuxi in their fishing grounds. We conducted an ethnobiological research at fishing communities of the region including about 70 active artisanal fishers. Our results showed that marine tucuxi is mainly classified by the interviewed fishers as life form 'fish' and named mostly as 'boto'. Fishers provided important information on the occurrence areas, group sizes, seasonality, reproduction, diet and interactions of marine tucuxi with fisheries. Fishers' ecological knowledge agreed with data obtained by local researchers and can bring new alternatives the marine tucuxi conservation and management in the northern coast of São Paulo State.

Resumen

El tucuxi marino (*Sotalia guianensis*) és una de las espécies más frecuentemente registrada en la costa norte del Estado de São Paulo (Distritos de Caraguatatuba, São Sebastião y Ilhabela), sea en varamientos, capturas accidentales o avistajes confirmadas por el *"Projeto SOS mamíferos Marinhos"* en 12 años de pesquisas. Los pescadores de la región tambíén confirman la presencia desta espécie en sus pesqueros, por lo cual empezamos un estudio etnobiologico con las comunidades pesqueras de de la región, que incluyó cerca de 70 pescadores. Nuestros resultados muestram que el tucuxi marino és principalmente considerado como un 'pez' y conocido por el nombre 'boto'. Además los pescadores aportaran informacciones acerca del area de occurrencia, tamaños de grupo, sazonalidad, reproducción, dieta y interacciones de los tucuxi marinos con la

pesca. El conocimiento ecológico de los pescadores está de acuerdo con datos obtenidos en pesquisas locales y puede ser útil en la elaboracción de nuevas estrategias de conservación y manejo para el tucuxi marino en esta región.

Introduction

Ethnobiology studies the relation among plants, animals and human societies, analyzing how people perceive and classify nature (Berlin 1992). Studies on folk knowledge have compiled biological information based on local knowledge, such as the study by Begossi and Figueiredo (1995). According to Berkes and Folke (2002) local ecological knowledge (LEK) is a cumulative body of knowledge and beliefs, evolved by adaptive processes and transmitted through generations, about the relationship of living beings with one another and with their environment. Additionally, ethnobiological studies have produced new approaches to conservation and management of natural resources (Begossi *et al.* 2002, Gadgil *et al.* 2003).

The northern coast of São Paulo State is 161km long and it is composed by 164 beaches and 17 islands. It encompasses the municipalities of Ubatuba, Caraguatatuba, São Sebastião and Ilhabela (Figure 1), which totalize a population of around 240.000 people. Currently, tourism is among the most important commercial activities in the region, followed by commercial artisanal fishing (Begossi 2006).

The marine tucuxi, *Sotalia guianensis,* is one of the most common species in this part of the Brazilian coast and it has been recorded there through sightings or occurrences of stranded or accidentally captured animals. Along the last 12 years, the research project *"Projeto SOS Mamíferos Marinhos"* recorded 30 dead individuals (26 stranded and 4 accidentally captured in gillnets) and groups of marine tucuxi were sighted in 11 occasions among 60 field trips (at land and boat cruises).

Marine tucuxi stranding records accounted for 17% of the total of marine mammals stranding in this period. During their fishing trips at sea, fishers from the northern coast of São Paulo have related the presence of marine tucuxi and other species of dolphins. In order to better understand the interaction between fishers and the marine tucuxi, we performed an ethnobiological research in 11 communities of Caraguatatuba, São Sebastião and Ilhabela.

In Brazil, we find some studies on Cetacean ethnobiology, including ethnoecological aspects. For example, Oliveira and Monteiro-Filho (2006) have studied the knowledge of fishers about marine tucuxi (*Sotalia guianensis*) in Cananéia and Ilha do Cardoso (São Paulo State), collecting information about social organization, behavior, feeding ecology, sense organs, spatial distribution, parental care, epimeletic behavior (helping behavior towards injured co-specifics), interspecific interactions and nocturnal activities. Pinheiro and Cremer (2002) have researched fishers knowledge about marine tucuxi (*S. guianensis*) and Franciscana dolphin (*Pontoporia blainvillei*), at Babitonga Bay (Santa Catarina State), recording information on classification, diet, feeding behavior, habitat use, group size, seasonality, accidental capture, and use of accidentally captured dolphins. At Maranhão State (northern coast of Brazil), Garri *et al*. (2006) have carried out interviews with local fishers to obtain information about meat consumption of marine tucuxi captured in fisheries activities.

The objective of this study is to characterize fishers' knowledge about marine tucuxi.

Material and Methods

The fishing communities to be included in this survey were selected by their importance in terms of the occurrence of artisanal fisheries, along with its geographical location, in order to obtain a representative range of information. The following communities were chosen: Cocanha, Camaroeiro and Porto Novo (Caraguatatuba), Enseada, São Francisco, Pontal da Cruz, Barequeçaba,

Toque-Toque, Paúba, Maresias, Boiçucanga, Barra do Sahy and Barra do Una (São Sebastião), Bonete, Portinho and Pier dos Pescadores (Ilhabela), totalling around 500 active artisanal fishers (Figure 2). We intended to interview 30% (n= 150) of this total, selecting only the fishers older than 35 years and residing and fishing at the local for at least 15 years. Currently, we have interviewed approximately 46 % of the fishers (n=70), all of them living at São Sebastião. The results presented in this study refer only to fishers from São Sebastião.

During the interviews we used pictures of marine tucuxi in the sea, in addition to drawings of this species. Semi-structured questionnaires (Appendix 1) were the basis for interviews, which included questions on the nomenclature, classification, occurrence, distribution, seasonality, group size, diet, reproduction, migration and interactions with fisheries. Additionally, we used pictures and drawings of other dolphins, which are common in the studied area, to evaluate the fishers' perception in relation to dolphin diversity and to observe how they group different dolphin's species.

The answers given by the fishers were recorded as ´citations´, being possible more than one citation per answer relative to each question. In order to standardize the results, we show the data as the total number of citations for each question asked in the questionnaire.

Fish species cited by fishers as prey of marine tucuxi were identified comparing their common names with the common names mentioned in the literature on ethnoichthyological research in the studied area (Begossi and Figueiredo 1995, Masumoto 2003).

Results

Among the 70 fishers interviewed in São Sebastião, with a mean age of 59 years, only one is a woman. Among them, 61 fishers have been fishing for more than 20 years. Thirty seven of the interviewees have concluded only the primary school.

In the first part of the interview, a general question about dolphins was asked to the fishers: - "Are dolphins fish? - Why?" As a result, 31 fishers answered that dolphins are fish and the most common explanations were: "they spend all their life at sea", (n=15) "they eat fish and live at sea" (n=5), "they are from the shark family" (n=7) and "they look like sharks, although they don't attack men" (n=1). Two citations refer to dolphins as "fish-mammals". On the other hand, 13 fishers answered that cetaceans are not fish and the most common explanations were: "they resemble fish but they aren't edible, their meat is not to sell". In fifteen citations, fishers mention that "dolphins are mammals" and two classified them as cetaceans, although another five fishers considered these animals very similar to fishes. Four fishers out of 70 did not know how to answer this question (Table 1).

In relation to recognition and nomenclature of the marine tucuxi, only eight fishers did not recognize this species. Among the answers provided by fishers, the name "boto" (a popular name used for dolphins) was cited by 45 fishers, "golfinho" (dolphin) by 12, and "toninha" by eight (a popular name usually used for another species, the Franciscana dolphin, *Pontoporia blainvillei*) (Table 2).

When we showed pictures of different dolphin species, including *Sotalia guianensis*, and asked fishers to group them, most fishers (23) formed a group including *S. guianensis* with *Tursiops truncatus*. They explained this group due to the similarity of these species, differentiated by bigger size of *T. truncatus*. Other 32 fishers did not grouped the dolphin's species and 15 fishers mentioned 26 groups formed by different combinations of the exposed dolphin's species.

In relation to the distribution of marine tucuxi, the results of interviews show that this species is commonly sighted by fishers on the studied coast (Figure 3). Fishers sighted this species usually while foraging, socializing or displacing from one area to another.

Other important aspects of the marine tucuxi ecology were also known by the fishers. Fishers mentioned different group sizes for marine tucuxi, from small groups (about 10 individuals) to large groups (more than 50 individuals) (Figure 4). When asked about the marine tucuxi habitat, in 45 answers fishers confirmed that these dolphins live in 'deep waters', while in 42 answers they considered them as coastal dolphins, which live in 'shallow waters' (Figure 4). One answer indicated this species as living in warmer waters and in 17 citations they didn't know about this species habitat. Talking about seasonality, there were 35 citations confirming that marine tucuxi is commonly seen year round, 12 citations mentioning that they see it during the winter, 7 pointed out that it is common in the summer and 17 fishers did not know the answer (Figure 4).

In relation to marine tucuxi reproduction, 54 fishers did not know about its reproduction. From 16 citations confirming the presence of calves among the groups sighted in the studied area, 3 related this presence to winter time.

The knowledge of fishers concerning marine tucuxi diet comprehended 25 answers that it eats "fish or small fish" (Table 3). "Tainha" and "parati" (mullets, *Mugil plaanus* and *M. curema*) were the fish most commonly mentioned, followed by "manjuba" (anchovy, *Anchoa* sp.), "sardinha" (sardine, *Sardinella brasiliensis*), "lula" (squid, *Loligo* sp.), "camarão" (shrimp, Penaeidae), "peixe-espada" (cutlassfish, *Trichiurus lepturus*), "pescadinha" (weakfish, *Cynoscion* spp., *Macrodon ancylodon, Nebris microps* or *Isopisthus parvipinnis*), "enchova" (bluefish, *Pomatomus saltatrix*) and other species (Table 3). Thirteen fishermen didn't know about the diet of marine tucuxi.

Regarding marine tucuxi interactions with fishing nets, in 42 citations fishers were evasive or deny knowing about accidental capture of dolphins. Three of them categorically denied any event of accidental capture. On the other hand, 15 citations confirm the possibility of accidental capture of marine tucuxis by gillnets. Other 15 citations referred to interactions between marine tucuxis and boats or fish, such as 'dolphins eat from gillnets' (n=1), 'they follow boats' (n=6), 'swim under the

boat' (n=1), 'turn belly up' (n=1), 'circle the fishes' (n=3), 'disperse the fishes' (n=1) and 'follow fish schools' (n=2).

Discussion

Fishers, despite their low level of formal education, have accumulated along their lives a detailed knowledge on marine environments. Folk taxonomy is a way of organizing this knowledge and, according to Hays (1982), reflects different human behavioral responses related to the salience of each organism. The salience of a biological group of organisms results from the degree of direct interaction between people and these organisms (Dougherty 1978).

According to Dupré (1999), until the beginning of the 80's, the folk taxonomy of marine animals commonly regarded whales as fishes, which meant any aquatic animal, especially vertebrates. Brown (1984) observed that the group of animals called 'fish' is a class of discontinuity (generally considered as a life form) that includes true fish, and in its great extension, fish-shaped mammals such as dolphins and whales. Nevertheless, as cetaceans became more exposed by the media, new information on their biology has been acquired by fishers. The fishers studied seem to be halfway of this change, acquiring new information that sometimes conflict with their old beliefs. Nearly half of them still consider whales and dolphins as fish 'life form', defined by them as any animal that lives in the sea, eating other marine animal or plant, in which category cetaceans could be easily included.

The process of recognizing and naming dolphins observed for the studied fishers might depend on dolphins relative abundance in the studied area. According to Medin and Atran (1999) two theories explain the origin of popular (or traditional) knowledge: utilitarism, in which popular knowledge is more detailed in relation to species that are useful to the community and mentalism (or intellectualism) in which local knowledge reflects the species abundance in the nature, its salience or

another perceptible feature. According to Berlin (1992), humans have the capacity of recognize and categorize plants and animals based on their morphological similarity and the most easily recognized taxa would be the generic. Our results indicated that marine tucuxi was readily recognized by fishers, which could be explained by its higher local abundance in relation to other dolphin species, by its coastal habits and its higher frequency of accidental capture in gillnets (Di Beneditto *et al.* 2001), which makes it very salient to fishers.

Folk names generally show local or regional variation in their use, but the most used, in this case, is "boto", a name used by fishers along the Brazilian coast for dolphins in general (Siciliano *et al*. 2006). This homogeneity in nomenclature used by the studied fishers is probably due to a high cultural salience of the dolphins. Brown (1985) suggests that highly salient organisms are named by unitary lexemes while lower salient organisms are generally named by binomials, as a way to facilitate their recognition. On the other hand, in spite of not have been commercially used by fishermen, dolphins are highly salient, both morphologically and culturally, what could explain why the studied fishers use only a generic nomination for different species. However more information would be important to fully understand the 'boto' denomination, considering its salience and, on the other hand, its commercially unimportance to fishers from São Sebastião.

Marine tucuxi distribution reported by fishers from S. Sebastião, in coastal waters and estuarine areas of the northern coast of São Paulo, agrees with literature information about this species (Jefferson *et al*. 1993; Martuscelli *et al.* 1996, Santos *et al*. 2000; Di Beneditto and Ramos 2004) and are coincident with records of this species by *Projeto SOS Mamíferos Marinhos* (Figure 3). The occurrence sites of marine tucuxi mentioned by fishers were also coincident to the main points of their fishing activities.

Sightings of marine tucuxi in the studied area, recorded by *"Projeto SOS Mamíferos Marinhos"*, revealed variation in relation to group size, from small groups (≤10 dolphins, n= 4) to

medium groups (11 to 50 dolphins, n= 7). Fishers' citations account for the occurrence of medium and large groups of marine tucuxi and some fishers (n=6) suggested that the variation in this dolphin's group size could be related to seasonality of some schooling fishes, which agrees with Azevedo *et al*. (2005). These authors, studying group characteristics of marine tucuxi in Guanabara Bay, found groups from one to 40 individuals and they suggest that group size may be a function of resources' availability in the area (Azevedo *et al*. 2005).

The lack of homogeneity in the answers about habitat, seasonality and reproduction (Figure 4) by fishers could be understood through the utilitarian point of view (Hays 1982). As dolphins are not targets in the fishery, fishers do not necessarily need to have knowledge about them in order to improve their catches. Another point to be considered is that other studies, such as Silvano and Begossi (2002) and Silvano *et al*. (2006), found that fish reproduction is a subject generally less known by fishers. They suggest that such lack of knowledge might be due to the difficulty of observing fish reproduction in nature. We suggest the same about dolphin's reproduction.

Di Beneditto *et al*. (2001) studying the diet of *S. guianensis* found as main prey species cutlassfish (*Trichiurus lepturus*), rockfish (*Porichthys porosissimus*), anchovy (*Anchoa fllifera*), weakfishes (*Paralonchurus brasiliensis* and *Isopisthus parvipinnis*), conger eel (*Ariosoma opisthoophthalma*) and squids (*Loligo sanpaulensis, L. plei* and *Lolliguncula brevis*). One species from this list (*Trichiurus lepturus*) and another prey from four families (Engraulidae, Sciaenidae, Trichiuridae and Lolliginidae) are coincident with information given by the studied fishers, confirming their knowledge about marine tucuxi diet (Table 3).

The fact that nearly 20% of the interviewed fishers mentioned the potencial accidental capture of *S. guianensis* in gillnets corroborates data obtained by local researchers, which show that this dolphin is the second most captured species in the studied area (Souza and Winck 2005). The occurrence of accidental catches of this species certainly contributes to its higher salience in relation

to other dolphin's species in the northern coast of São Paulo, since fishers have the opportunity to see the captured dolphins in detail. Data obtained by local researchers point to gillnets as the main fishing gear involved in the incidental catches, but further investigation is necessary to determine critical areas in the studied area and obtain CPUE values for *S. guianensis* in order to evaluate local level of danger to which this species is exposed.

The results of this survey show that fishers of the northern coast of São Paulo State retain a relatively detailed knowledge about marine tucuxi. One of the main concerns of fishery management is the fishing strategy adopted by fishers. These strategies could be better understood if we address fishers' local ecological knowledge (Silvano and Begossi 2005). This knowledge can be a useful tool helping to point the most impacting fishing nets and to determine conservation areas for the marine tucuxi in the northern coast of São Paulo.

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Figures

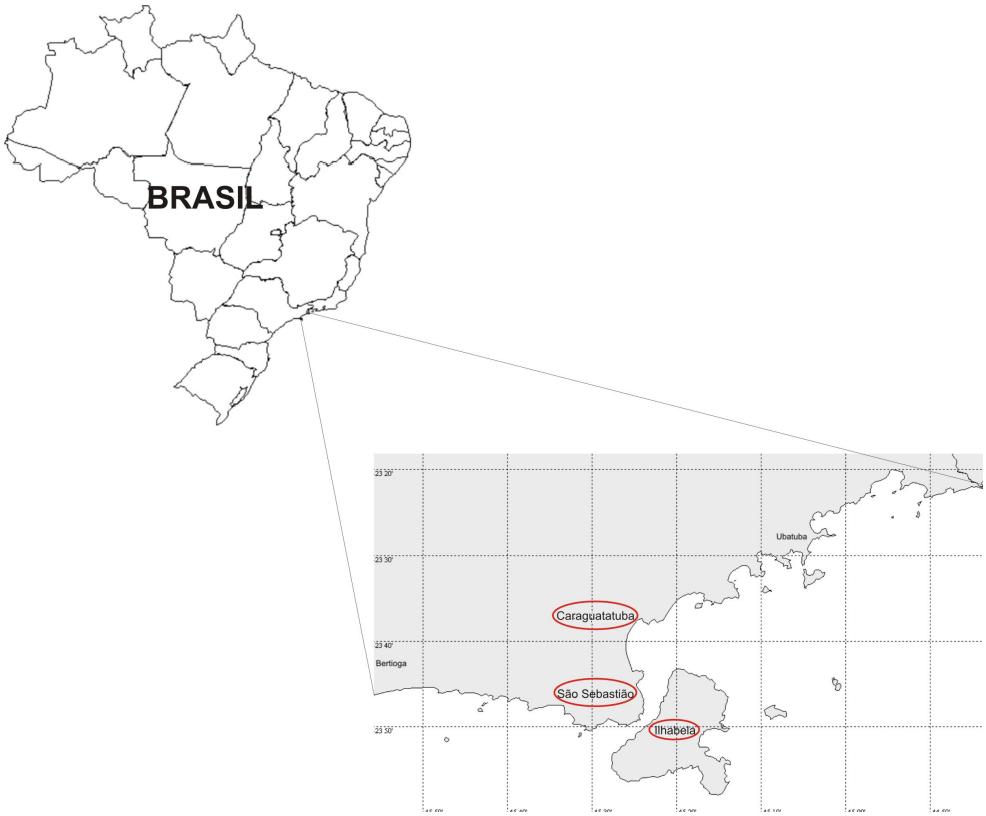

Figure 1. Northern coast of São Paulo State, Brazil, showing the studied localities (23° 21'S – 44° 41'W to 23° 41'S – 45° 53'W).

Figure 2. Fishers repairing gillnets during interviews at Boiçucanga beach, São Sebastião, São Paulo, Brazil.

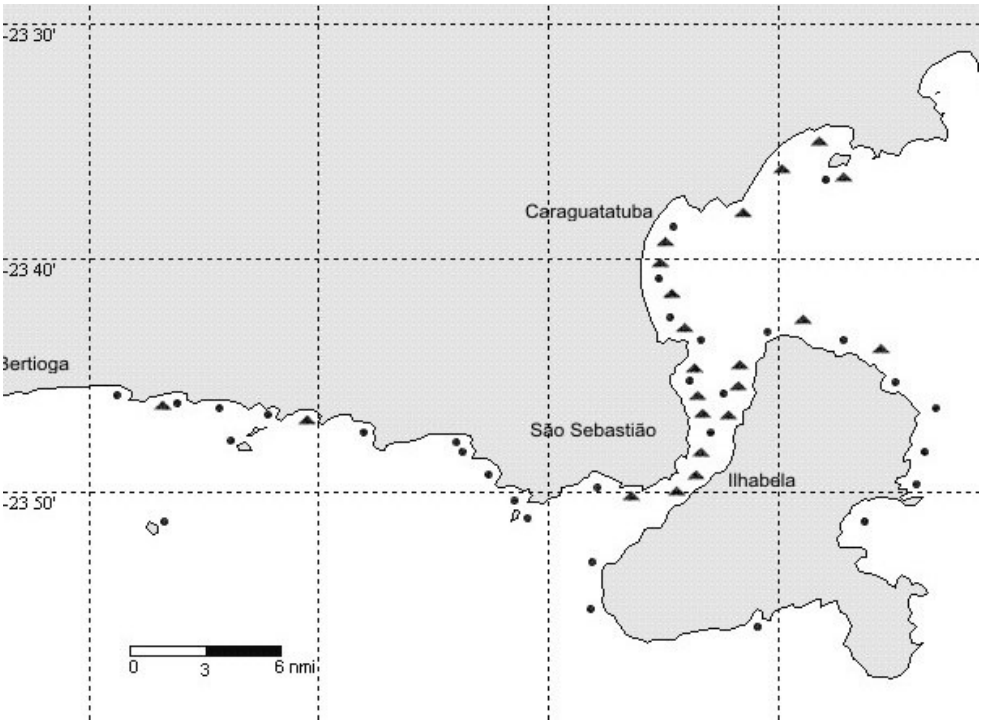

Figure 3. Distribution of *Sotalia guianensis* around São Sebastião and Ilhabela according to fishers' information (black dots) and to the records of *Projeto SOS Mamíferos Marinhos* (black triangles).

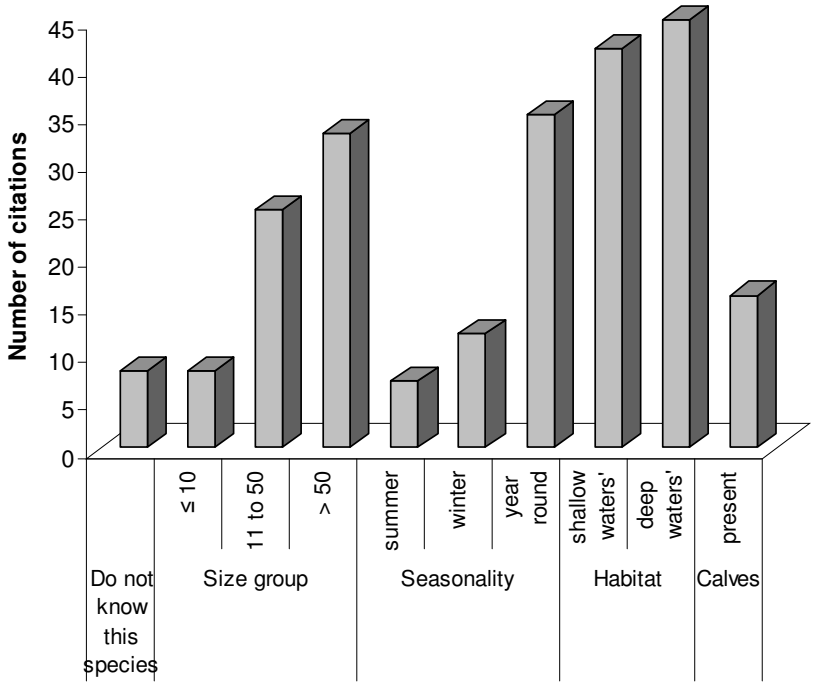

Figure 4. Ecological aspects of marine tucuxi cited by fishers from São Sebastião.

Tables

Table 1. Fishers' classification of dolphins in São Sebastião.

Fishers classification	Number of total citations	Additional observations	Number of citations
"Dolphins are fish"	31	'are fish-mammals'	2
"Dolphins are not fish"	13	'look like sharks'	4
"Dolphins are mammals"	15	'look like fish'	5
		'are cetaceans'	2
Don't know how to classify	3	---	---
Total of citations	70	---	---

Table 2. Marine tucuxi names given by the interviewed fishers (n=70) in São Sebastião.

Scientific name	English name	Local name		Number of citations	Don't know the animal
		Generic	Binomial		
Sotalia guianensis	Marine Tucuxi	**Boto**		**45**	8
			boto preto	1	
		golfinho		**12**	
			toninha	**8**	
Total of citations					**74**

Table 3. Prey items from the diet of *Sotalia guianensis*, according to citations of fishers from São Sebastião, SP. Species and Families cited in the literature (Di Beneditto *et al.* 2001) as main prey items from marine tucuxi's diet are highlighted.

Prey	Biological Family	Biological species	Folk name	Number of citations
Fish (in general)		---	Peixe	24
Small fish (in general)		---	Peixe pequeno, comedio	7
Sardines	Clupeidae	*Sardinella brasiliensis*	*Sardinha*	8
Menhaden	Clupeidae	*Brevoortia pectinata*	*Savelha*	1

Broadband anchovy	Engraulidae	*Anchoa* sp.	*Manjuba*	10
Mullet	Mugilidae	*Mugil platanus*	*Tainha*	49
White mullet	Mugilidae	*Mugil curema*	*Parati*	22
Weakfish	Sciaenidae	*Cynoscion* sp.	*Pescada, pescadinha*	2
Southern kingcroaker	Sciaenidae	*Menticirrhus* sp.	*Betara*	1
Cutlassfish	Trichiuridae	*Trichiurus lepturus*	*Espada*	2
Bluefish	Pomatomidae	*Pomatomus saltatrix*	*Enchova*	2
Leatherjack	Carangidae	*Oligoplites* sp.	*Guaivira*	1
Jacks	Carangidae	*Caranx* sp.	*Xaréu*	1
Blue runner	Carangidae	*Caranx crysos*	*Carapau*	2
Grouper	Serranidae	*Epinephelus marginatus*	*Garoupa*	1
Squid	Lolliginidae	*Loligo* sp.	*Lula*	4
Shrimp	Penaeidae	*Xiphopenaeus kroyeri, Litopenaeus schimitti*	*Camarão*	3
Do not know		---		13
Total citations		---		153

Appendix 1

1-	Are dolphins fish? If yes / no, why?
2-	Do you know this animal? How do you call it?
3-	Where have you seen this animal?
4-	When do you see this animal (season or month)?
5-	What does this animal feed on?
6-	Where does it live?
7-	Does it move alone or in group? Groups of how many animals?
8-	Have you seen calves in the groups? In what season / month?
9-	What animal could attack this animal?
10-	In your opinion, how is the interaction between this animal and fisheries activities?
11-	Do you think these animals (dolphins) could be grouped? How? Why?

CONSIDERAÇÕES FINAIS

Golfinhos-comuns (*Delphinus* sp.) nas águas do Arquipélago dos Alcatrazes, em São Sebastião.

Considerações Finais

1. Apesar do aparente declínio da pesca artesanal como atividade econômica no litoral norte paulista, algumas comunidades de pescadores ainda retém um conhecimento detalhado sobre o ambiente marinho em geral, incluindo espécies não diretamente exploradas, como as baleias, botos e golfinhos.
2. Os pescadores percebem os cetáceos em função de sua saliência fenotípica (morfológica) e cultural, não atribuindo um caráter utilitário a estes animais. Os cetáceos raramente são utilizados pelos pescadores quando capturados acidentalmente em redes de pesca, seja por questões culturais ou devido ao respeito que demonstram às leis que protegem os cetáceos.
3. O reconhecimento de algumas espécies pelos pescadores, como a toninha, a baleia-jubarte, a orca e o boto-caldeirão confirma a realidade da espécie, uma vez que utilizando como critério as saliências fenotípica e comportamental dos cetáceos que avistam diariamente, os pescadores conseguiram classificar e nomear indivíduos sob espécies 'folk', que coincidiram com as espécies lineanas.
4. As espécies de cetáceos mais reconhecidas pelos pescadores não são necessariamente as mais abundantes localmente, e sim as mais freqüentemente capturadas em redes de pesca e as de maior tamanho corporal, mesmo que estas ocorram mais esporadicamente. As espécies de cetáceos que têm sido expostas pela mídia televisiva também foram prontamente reconhecidas, classificadas e nomeadas, demonstrando a influência da globalização sobre a cultura local, o que pode interferir nos mecanismos locais de transmissão cultural.

5. O fato dos cetáceos serem classificados como peixes por mais de um terço dos pescadores entrevistados reflete a persistência da transmissão cultural ao longo das gerações, reforçando um 'meme', ou uma variante cultural, que contraria as informações atualizadas que eles recebem através da mídia e do contato com pessoas que não compartilham da cultura caiçara.
6. O conhecimento dos pescadores sobre espécies de cetáceos consideradas ameaçadas é valioso para a conservação das mesmas, contribuindo com informações sobre aspectos bio-ecológicos pouco estudados em relação a estas espécies ou apontando para novas possibilidades de pesquisa. Muitas espécies de cetáceos ainda são tão pouco estudadas que vale a pena considerar todas as informações que puderem ser obtidas sobre elas, principalmente quando se trata do conhecimento empírico dos pescadores.
7. A alta concordância entre o conhecimento dos pescadores de São Sebastião em relação à ecologia dos cetáceos, o conhecimento de pescadores de outros pontos da costa sudeste e sul do Brasil, os dados locais coletados por pesquisadores e a informação publicada na literatura científica, atesta o valor das culturas locais. Indica também que padrões biológicos são percebidos de forma semelhante por pescadores de culturas e locais diversos.
8. A contribuição dos pescadores, seja por meio de seu conhecimento sobre as espécies, ou por meio das técnicas de manejo que utilizam em relação ao uso de recursos naturais, pode indicar alternativas que contribuam para lidar de forma eficiente com as mudanças dinâmicas que têm ocorrido nos ecossistemas marinhos.
9. A participação direta dos pescadores em projetos de pesquisa e em planos de co-manejo de recursos marinhos, além de contribuir com a conservação de recursos naturais, pode ter um papel importante na valorização da cultura local.