Chapter 10
Elasmobranchs Consumption in Brazil: Impacts and Consequences

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Abstract  Commercial fisheries struggle to apply regulatory and legal mechanisms that depend on reliable species-specific data, and the shark industry faces an even greater obstacle to transparency with sellers changing product names to overcome consumer resistance. Fraudulent representation or mislabeling of fish, including sharks and rays, has been recorded in some countries. In Brazil, for instance, sharks are sold as “cação” – a popular name attributed for any shark or ray species; however, according to consumer’s knowledge of a large city of southern Brazil, more than 70% of them are often unaware that “cação” refers to sharks. Today, the Brazilian market has a high interest in encouraging people to eat “cação” meat, mainly because of their attractive prices. This raise a number of questions, mainly in respect to the knowledge of people/consumers, as what are they eating, and why the Brazilian meat market has grown so much in the last years.

10.1  Introduction

The Chondrichthyes, or cartilaginous fish (i.e sharks, rays, skates and chimaeras), are among the oldest taxa of vertebrates and have survived on planet earth for over 400 million years, including 4 mass extinction events (Camhi et al. 1998; Musick 1999). It can be considered an evolutionary successful group because it has diverse reproductive strategies (including parthenogenesis), ranging from planktivorous to top predators, occupying practically all aquatic niches (Priede et al. 2006; Snelson...
et al. 2008). Sharks, skates, and rays composes the subclass Elasmobranchii (i.e. elasmobranchs) currently comprising a group of approximately 1150 species (Nelson 2006). Due to the development of a differentiated mandibular apparatus and an accurate sensorial system, elasmobranchs became predominantly predators, usually occupying higher or intermediate trophic levels (Camhi et al. 1998; Musick 1999). Therefore, they usually occur in relatively smaller abundances than species of lower trophic levels (Walker 1998; Stevens et al. 2000) though playing an important role in maintaining marine ecosystems healthy (e.g. control of genetic quality of populations, Holden 1974).

Elasmobranchs are long lived species characterized by low productivity rates which generally implies in small litters, slow growth rates and late onset of sexual maturity (Cortes et al. 2002; Garcia et al. 2008). These features are associated to high vulnerability and extinction risk, whereas populations have limited recovery capacity following overexploitation by fishing and even habitat losses and/or degradation (Smith et al. 1998; Stobutzki et al. 2002). A great diversity of elasmobranchs has been explored by modern fisheries, regularly caught as by-catch (i.e. incidental) and more recently (>1990) as target, especially in longline, trawl and gill nets fisheries (Bonfil 1994; Baum et al. 2003; Barreto et al. 2016).

Population declines have been documented for several elasmobranchs species worldwide (Hutchings 2000; Baum et al. 2003; Ferretti et al. 2010; Clarke et al. 2011; Barreto et al. 2016). There are well-documented cases of elasmobranchs populations that collapsed such as *Lamna nasus* in the North Atlantic; *Galeorhinus galeus* in California and Australia; *Cetorhinus maximus* in England; *Squalus acanthias* in the North Sea and British Columbia; *Pristis pectinata* in Florida and Louisiana, and large coastal sharks off the west coast of the United States, such as *Carcharias taurus* and *Carcharhinus obscurus* (International Union for Conservation of Nature – IUCN). The IUCN reports that approximately 30% of elasmobranchs are threatened with extinction (Dulvy et al. 2014). Worryingly, 47% of extant species do not have minimal information to be evaluated under the IUCN classifying system (Dulvy et al. 2014; Mace et al. 2008).

### 10.2 Elasmobranch Fisheries in Brazil

South Atlantic fisheries, specifically assessed from Brazil during the late 1990s reached critical levels for spiny angel shark *Squatina guggenheim*, hidden angel shark *S. occulta*; Brazilian guitarfish *Rhinobatos horkelli*, scalloped hammerhead shark *Sphyrna lewini*, sand tiger shark *Carcharias taurus*, school shark *Galeorhinus galeus* and narrownose smooth-hound *Mustelus schmitti* (Vooren 1997; Lessa et al. 1999). More recently (between 2010 and 2012), Brazil reassessed elasmobranchs following the IUCN’s system, resulting in 33% of species in threatened categories (VU = 19; EN = 8; CR = 28), and 36% for which the available information did not allow for any sort of categorization (i.e. Data Deficient-DD) (ICMBio 2016). This result overcomes the global rate of threatened species (approximately 25% – Dulvy et al. 2014).
The situation of large pelagic elasmobranchs currently is very worrying. According to Barreto (2015), which analyzed CPUE and demography of pelagic shark species from Brazil, most populations are currently depleted. Around 13 species have been caught by local and international longline fishing fleets since the 1950s, specifically: shortfin mako shark (*Isurus oxyrinchus*), longfin mako shark (*I. paucus*), porbeagle shark (*Lamna nasus*), blue shark (*Prionace glauca*), oceanic whitetip shark (*Carcharhinus longimanus*), dusky shark (*C. obscurus*), night shark (*C. signatus*), crocodile shark (*Pseudocarcharias kamoharae*), common thresher shark (*Alopias vulpinus*) and bigeye thresher shark (*A. superciliosus*), scalloped hammerhead shark (*Sphyrna lewini*), smooth hammerhead shark (*S. zygaena*) and great hammerhead shark (*S. mokarran*) and the pelagic stingray (*Pteroplatytrygon violacea*).

These species have historically sustained the international fin market (Amorim et al. 1998; Hazin et al. 2008; Domingo et al. 2014) and since the 1990s, more precisely after the Brazilian finning ban, became one of the most cheap sea food to be consumed in Brazil. The blue shark, for instance, probably for being the only species that apparently has not yet collapsed, is currently supporting an industry that has grown absurdly in recent decades. Although this species has no capture restrictions in the region, it is currently the main target of longline pelagic fisheries in the South Atlantic, especially in periods where catches of other pelagic fish of high commercial demand (i.e. tunas and billfishes) are lower. Worryingly, both in tuna fishing and swordfish, as in fishing for blue shark, a number of other extremely sensitive sharks, with considerably lower population abundances than the target species are often caught. Finally, Brazil has been recently identified as a global flow channel for shark carcasses (world’s largest importer) (Dent and Clarke 2015). Over the last 15 years the country has imported large quantities of shark carcasses from international fleets (>20) which also export fins for international luxury markets channels.

While for oceanic species, despite the limitations, there is some catch information available (mainly due to the industry and their obligations with the government, i.e. fishing statistics, commercial and financial transactions) coastal shark species are far to have their catches known. Large species such as hammerhead sharks, sand-tiger, and also the medium sized daggernose, blacknose and the southern squatinids are at great risk due to coastal fisheries (Barreto et al. 2011; Lessa et al. 2016) and for small and medium-sized species, there is no information about fishing or life history. These species are commonly caught by small-scale fisheries, which in a country with one million registered fishermen in this category, which contributes with 45% of the total fish produced in the country is too big to be ignored (B. Padovani, personal communication). The combined effect of oceanic industrial fishing and the coastal small-scale fisheries can be additive or even synergistic on population depletion due to its spatial complementarity. This relation still needs small-scale fisheries catch data to be assessed.

Rays production in Brazil has always been neglected. In the state of Santa Catarina, main Brazilian elasmobranch producer and one of the last to stop their fishing statistics collection, the ray production increased more than threefold in ten
years (from 452,367 kg in 2000 to 1,425,792 kg in 2010). This state reported that more than 2300 tons of elasmobranchs were landed in 2010, whereas over 85% were not identified at species level (UNIVALI/CTTMar 2011). This broad identification levels of landed species makes species-specific regulation very difficult (Bornatowski et al. 2011, 2014), precluding fishing controls. Major concerns however lie in the categorization of ray’s species. In Brazilian fisheries some ray species are grouped under a category called “emplastro”. Within this label there are at least seven species: bignose banskate (*Sympeterygia acuta*, endemic); smallnose fanskate (*S. bonapartii*, endemic); rio skate (*Rioraja agassizi*, endemic); spotback skate (*Atlantoraja castelnaui*, endemic); la plata skate (*A. platana*, endemic); eyespot skate (*A. cyclophora*); and the bluntnose stingray (*Dasyatis say*). Today, the demand of ray meat (“emplastro” group) for the Korean markets is so great that was one of the critical steps to invalidate the Normative Instruction-445 (Brazil 2014), which the main goal was to regulate the use of seafood products.

### 10.3 The Problem of Mislabling

Commercial fisheries struggle to apply regulatory and legal mechanisms that depend on reliable species-specific data, and the shark industry faces an even greater obstacle to transparency with sellers changing product names to overcome consumer resistance. Fraudulent representation or mislabeling of fish, including sharks and rays, has been recorded in some countries (e.g. Barbuto et al. 2010; Jacquet and Pauly 2008; Lamendin et al. 2015; Smith and Benson 2001; Wong and Hanner 2008), highlighting the impacts on the economy and ecosystem services (Jacquet and Pauly 2008). The European Union, on the other hand, requires listing the species name on shark products (see Fig. 10.1) to avoid fraud and to aid conservation (Council Regulation No. 104/2000 – December/1999). With these measures rates of seafood fraud appear to have decreased from 2011 to 2015 (Oceana 2016).

While many developing countries depend of fish meat (including shark and ray meat) for their subsistence, many other countries view shark meat as low-quality and therefore commercialize them under generic names to overcome consumer resistance (Vannuccini 1999; Bornatowski et al. 2013, 2015; Dent and Clarke 2015). This measure impedes consumers to link the meat they buy to the animals they know. For instance, the spiny dogfish is sold under names like “saumonette” in France, “schillerlocken” or “seeaal” in Germany, and “spinaroli” in Italy (WildAid 2007). Shortfin mako (*Isurus oxyrinchus*), porbeagle (*Lamna nasus*) and thresher sharks (*Alopias* spp.) are considered to have a highly palatable meat worldwide and sometimes even comparable to swordfish (*Xiphias gladius*) in Europe and USA (WildAid 2007). On the other hand, blue shark (one of the most important shark species in fisheries) is considered one of the less preferred species for human consumption due to its soft and strong flavoured meat.
In Brazil, sharks are sold as “cação” – a popular name attributed for any shark or ray species (Fig. 10.2). People frequently purchase shark meat in pieces as ‘fillet’ or ‘thermidor’. The most common dish made with elasmobranch meat is a traditionally dish called “Muqueca”. This dish is originally from Espírito Santo, in the Southeast of Brazil, and also from the state of Bahia, in the Northeast.

Curiously, shark meat were not part of the traditional Brazilian diet and is considered to be low-value seafood (values around U$2.00/Kg$\textsuperscript{−1}) if comparable to more common fish such as tilapia (\textit{Tilapia} spp. and \textit{Oreochromis niloticus}), flatfish (\textit{Paralichthyidae} family), salmon (\textit{Salmon salar}), croacker fish (\textit{Cynoscion} spp.), snook (\textit{Centropomus} spp.), groupers (\textit{Serranidae} family) and snappers (\textit{Lutjanidae} family) and others. However, today the Brazilian market have a high interest in encouraging people to eat “cação” meat, mainly because of their attractive prices (as cited above), unfamiliarity with the product and to avoid meat waste (Ministério da Agricultura, Pecuária e Abastecimento – MAPA). The high interest of Brazil for elasmobranch meat turns it into the perfect “port for meat discard” (finning is prohibited in several regions).

Furthermore, shark meat is traded without labeling and at substantially lower prices under the name of “cação” and not as “shark” or “ray” (Fig. 10.2). This raise a number of questions, mainly in respect to the knowledge of people/consumers, as what are they eating, and why the Brazilian meat market has grown so much in the last years.

According to consumer’s knowledge of a large city of southern Brazil, more than 70% of them are often unaware that “cação” refers to sharks, and more than half of respondents claimed to have already eaten “cação” but never eaten sharks or rays (Bornatowski et al. 2015). So, consumers are buying “a pig in a poke”. Beside of that, in surveys made in southeastern Brazil (states of São Paulo and Rio de Janeiro), 62% of fish sold as groupers were actually sharks (Estrella et al. 2014). This mislabeling provokes a 25% increase in revenue. Unfortunately, the problem does not stop there and this may be only the tip of the iceberg.

The mislabeling may preclude people from taking health- and/or conservation-related decisions concerning the consumption of elasmobranch meat and thus interfere with efforts to reduce consumption or redirect consumption towards non-threatened species (Barbuto et al. 2010; Bornatowski et al. 2013; Jacquet and Pauly 2008). Furthermore, misleading product descriptions is a crime according to Brazilian Consumer Protection Code (nº 8078/1990) (Brazil 1990). A recent study
found that samples labeled under the name “cação” in Brazil were in fact made up of endangered scalloped hammerhead (Carvalho et al. 2015). Another study showed that 55% of “cação” samples were actually large-tooth sawfish, *Pristis perotteti*, a species considered by the IUCN to be critically endangered and for which trade is prohibited in Brazil (Palmeira et al. 2013). The generalization of species in a single name (such as “cação”) is therefore putting in risk several threatened species. In 19 October 2016, an online journal published a matter on “Sharks and rays threatened that are irregularly commercialized in Brazil” (http://economia.uol.com.br/noticias/efe/2016/10/19/tubaroes-e-raias-em-extincao-sao-comercializados-irregularmente-no-brasil.htm). More than 16 different species of sharks and rays were sold as “cação”, with special concern to the hidden angel shark *Squatina occulta*, and scalloped hammerhead shark *Sphyrna lewini* (23% of samples) classified as critically endangered and vulnerable respectively according IUCN redlist. In southern Brazil, artisanal fisheries capture a lot of sharks, including some threatened species that are also sold as “cação” for consumers in local markets (Figs. 10.3 and 10.4).

This lack of knowledge is also of great concern to human health because shark meat contains high levels of heavy metals (lead and mercury) due to biomagnification (Escobar-Sánchez et al. 2011; Lopez et al. 2013; Pethybridge et al. 2009). A study analyzing specifically blue sharks collected from strategical landing points of central and southern Brazil, found 70% of the samples with mercury levels above recommended (Dias et al. 2008). Brazil has less stringent restrictions for heavy metals in seafood than the European Union, North America, and Asia, allowing products

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Fig. 10.3  Scalloped hammerhead sharks (*Sphyrna lewini*) and other *Carcharhinus* spp. captured by artisanal fisheries in Paraná coast. Specimens are without heads and will be cut in slices and sold as “cação” (Photo by Isabella Simões)
Fig. 10.4 Scalloped hammerhead sharks (*Sphyrna lewini*) and other *Carcharhinus* spp. sharks captured by artisanal fisheries in Paraná coast. Specimens landed after evisceration (Photo by Isabella Simões)

Fig. 10.5 Children’s tests shark meat to be included in the scholar meals system (Photo by: Ana Chaffin, Macaé-RJ)
with high levels of heavy metals, which would not be marketable elsewhere, to be commercialized legally. The worst is that unlabeled shark meat has been served in public schools from several cities to children from 6 to 17 years old, as subsidized meat by the government (http://macae.rj.gov.br/semed/leitura/noticia/alunos-testam-file-de-cacao-na-merenda-escolar) (Fig. 10.5).

10.5 Actions and Suggestions

We therefore emphasize that a small list of actions need to be taken if developing countries, specially Brazil, to overcome major conservation barriers. They are:

1. Use of scientific names on commercialized products, and use of exclusive popular names in labels. A correct species-specific identification would aid in the solution to the mislabeling of shark meat
2. Supermarkets or any other final seller should be held legally responsible for the identification
3. Development of an identification handbook based on morphological characteristics (on muscle, for instance) to be used by regulatory agencies. This would be a cheap method to prevent fraud in identification. Muscle tissue identification methodology is already applied for teleostean fish (http://www.agricultura.gov.br/arq_editor/manual%20pesca.pdf), and could be used for elasmobranchs also.
4. Use of genetic techniques such as DNA barcoding for species-identification
5. Certification programs such as the Marine Stewardship Council (MSC) and eco-labels, may help consumers to choose more sustainable seafood products (Jacquet and Pauly 2008; Lamendin et al. 2015; Sampson et al. 2015; Von der Heyden et al. 2010). The establishment of species-specific commodity codes can facilitate trade monitoring of protected species, and also inform end consumers. This kind of information should be available to consumers
6. Restructuration of fisheries monitoring programs, and creation of a national program of fishery statistics with wide spatial and temporal coverage, with extensive species-catch monitoring throughout the Brazilian coast
7. Trained personnel to obtain reliable data following the correct identification of elasmobranchs species. Without knowing fishery catches (item 6) and correct species-specific information, any monitoring will fail.

References

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