EVALUATING THE SURVIVORSHIP OF ELASMOBRANCHS CAPTURED BY BOTTOM TRAWLERS:
A Pilot Plan for Conservation of Sharks, Skates and Rays.

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MACN CONICET

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Table of Contents

Table of Contents 3

Introduction 4

Changes in fish community structure 8
Chondrichthyan fisheries in Argentina 9
Buenos Aires province coastal waters skate community 11

Project Aims and Objectives 11

Project Implementation 13

Methodology of the scientific activities 13
Results 16

Educational Plan 18

Education goals 18
Targets of the educational work 18
Workshop for teachers, community leaders and fishermen 19
Didactic material and panellists 20
Programme and activities 21

Other Outputs 24

Highlights & Conservation Problems 25

Recommendations 25

References 26

INTRODUCTION

Chondrichthyans are a common but unspecified by-catch in many fisheries worldwide, particularly those using bottom trawls. In most countries, there are no regulations over the amount taken. Unfortunately, little skate species-specific data are available from areas with the highest catches, and virtually nothing is known about the status of individual stocks. However, large annual or rapidly increasing landings in recent times are cause of concern.

In view of the high endemism (possibly up to 55% of 230 known species), skates currently represent one of the most threatened groups of all marine species. However, assessing their vulnerability is difficult due to the practice of aggregating catch statistics.

Concerns over the impact of fishing on shark and batoid populations around the world are currently being raised at an international level through a number of *fora*. The Species Survival Commission of IUCN has formed the Shark Specialist Group (SSG), which is working on a global Action Plan for the conservation and management of sharks. The parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) took unprecedented action in 1994 by mandating a review of the status and trade in sharks, a group of animals not currently listed on the CITES Appendices. As part of the process of CITES consults, the United Nations Food and Agriculture Organization (FAO) began a work with the topic and set up a Technical Working Group (TWG) on sharks.

Concerns rising about chondrichthyans involve several factors. Sharks and batoids appear to be particularly vulnerable to over exploitation because of their K-selected life-history strategy –characterized by slow growth, late attainment of sexual maturity, long life spans, low fecundity, and natural mortality, and a close relationship between the number of young produced and the size of the breeding biomass–.

The poor record of sustainability of fisheries targeted shark species is cited as evidence of their vulnerability, but is also magnified by the fact that few countries have tools of management for these resources. Poor baseline data on species identification and landings have been collected because sharks have historically been of low economical value in most countries, and lack of data is crucial in the concerns.

As many of the landings of sharks becomes from fisheries targeting other species or from multispecies fisheries, or are in countries without adequate fisheries information-gathering systems, much of the catch goes unrecorded. Compounding the problem is the oceanic and highly migratory nature of many species, placing them outside the responsibility of individual countries and outside the mandate of international bodies. These factors have contributed to a situation where the reported chondrichthyan catch is only about half of the estimated global catch (Bonfil, 1994).

There is ample historic evidence of major declines in chondrichthyan populations from fisheries around the world. Global reported landings of chondrichthyan fishes have been increasing steadily since 1984 and in 1996 stand about 760,000 t (Stevens *et al.*, 2000). However, the total catch is probably nearer to 1.5 million tones, due to a large unreported by-catch (Bonfil, 1994).

During the 1940's, several target shark fisheries developed in response to the market for vitamin A from livers; more recently, fisheries have targeted chondrichthyan for their meat, fins, livers, and other products. The literature contains many references to the apparent "boom and bust" pattern of this fisheries during the 1940–1970 period (Holden, 1974; Anderson, 1990; Compagno, 1990). In most cases, economic and marketing factors were involved in the collapse and it is difficult to disentangle these from biological factors. Where the

species has a more restricted range and where the fishery was intensive and expanded rapidly, stock collapse become more plausible.
Over the last 20 years, a serious decline has been documented for a number of batoid species. The common skate (*Dipturus batis*) has been "brought to the brink of extinction" by trawling in the Irish Sea (Brander, 1981) and the barndoor skate (*D. laevis*) could become the first well-documented example of extinction in a marine fish species if current trends continue (Casey & Myers, 1998).

Roberts & Hawkins (1999) addressed the issue of marine extinctions. Only one species, the barndoor skate (Casey & Myers, 1998), is known to have been driven to the verge of extinction due to large scale fisheries operations. Three other skates are considered locally extinct, the common skate, the long nose skate (*Dipturus oxyrhinchus*), and the white skate *(Rostroraja alba*) (Brander, 1981; Dulvy *et al.*, 2000). Hoenig & Gruber (1990) suggested the possibility of ranking species according to their resilience based on critical aspects of their life history. They considered that natural mortality rate, age at maturity, fecundity, and, in particular, the intrinsic rate of population increase might be useful for this purpose.

Brander (1981) and Walker & Hislop (1998) demonstrated that changes in fecundity have a relatively small effect on the mortality at which the Irish Sea stock of the common skate and North Sea populations of rajoids collapse. Rather, it is the net recruitment rate that is important, and juvenile survival appears to be the key factor. Brander (1981) concluded that increased survival of juveniles provides grater resilience to fishing pressure than increased fecundity. In reality species may show a combination of different compensatory changes.

Pratt & Casey (1990) reviewed reproductive and growth parameters that might be used to indicate vulnerability of chondrichthyans species to fisheries, while Smith *et al.* (1998) ranked 26 species according to their intrinsic rate of population increase, providing a relative measure of their recovery ability from exploitation ('rebound' potential).

Brander (1981) ranked various skate species according to the total mortality that their populations could withstand without collapsing, based on age at maturity and fecundity. Walker & Hislop (1998) produced a similar ranking using demographic models that estimated levels of total mortality below which the populations decline. The larger, late maturing species, such as *D. batis*, tended to be the least productive among the skates species examined.

Demographic parameters such as rebound potential may be the most useful for ranking species for management or conservation prioritization. However, there are significant problems in obtaining suitable data to allow consistent calculation of the different parameters required for large numbers of species (Smith *et al.*, 1998).

Most life history trait variation, including growth, age at maturity, offspring size, and fecundity, is correlated with body size (Holden, 1973; Brander, 1981; Casey & Myers, 1998). As a result, body size is correlated to demography (Walker & Hislop, 1998; Dulvy *et al.,* 2000). In the North Sea, the four largest species have undergone declines, while the two smallest species have increased in abundance (Walker & Heessen, 1996; Rijnsdorp *et al.,* 1996; Walker & Hislop, 1998). In the Irish Sea, there is evidence for localized extirpation of the three largest species over the past century. Of the remaining five species, the two largest ones are declining in abundance, whereas the two smallest species have increased in abundance (Brander, 1981; Dulvy *et al.,* 2000). Although the largest species, the barndoor skate, has been nearly extirpated in the northern part of its range and is at very low abundance in the southerly part of its range (Casey and Myers, 1998), the next largest species, the winter skate (*Leucoraja ocellata*), is increasing in abundance and some smaller skates are decreasing in abundance. However, such a pattern is less clear for the skates of Southwestern Atlantic.

Changes in fish community structure

Most elasmobranches are predators at, or near, the top of marine food chains. How does their removal affect the structure and function of marine ecosystems? The direct effects of fishing through the capture of individual species can result in changes in abundance, size structure, life history parameters (density-dependent change), and at the extreme, could lead to extinction. The indirect effect involves trophic interactions at the community level through selective removal of predator or prey species, removal of competitors, species replacement, and enhancement of food supply through discards.

Large scale exploitation has led to changes in fish community structure. A decrease in abundance, particularly of the larger size classes, is a common feature of exploited fish populations (Russ, 1991). Fishers tend to remove the largest species first and then way down the food chain catching smaller species (Pauly *et al.*, 1998). Small species may also be less desirable on the market, and may therefore be subjected to lower fishing mortality (Jennings & Kaiser, 1998; Jennings *et al.*, 1999b). Species replacement over a period of about a decade has been reported on Georges Bank (Murawaski & Idoine, 1992), while in the other areas such a pattern is either not evident (North Sea; Pope *et al.*, 1988) or not consistent over several years (Scotian shelf; Duplisea *et al.*, 1997).

Skates tend to be generalist bottom feeders and there is considerable dietary overlap between species. Dulvy *et al.* (2000) suggest that the removal of larger skates may have led an increase in smaller skates through increased food availability. This competitive release has also been suggested as the reason for the increase of *A. radiata* in the North Sea (Walker & Heesen, 1996).

Jennings & Kaiser (1998) conclude that intraspecies competition and predation has rarely been shown to control cycles in fish populations and those there little convincing evidences to suggest that fishing has caused compensatory replacement of one fish stock for another. Daan (1980) also concluded that clear cases of species replacement due to fishing were hard to find. The assumption of replacement of species supposes that skates and rays share their food niche.

Chondrichthyan fisheries in Argentina

Among the first biologic researches on sharks made in Argentina (Berg, 1895; Lahille, 1921a, 1921b and 1928; Marini, 1929 and 1930; Pozzi & Bordalé, 1935; Marini, 1936; López, 1947), only Siccardi (1950) considered the fishing problem when she published the oldest statistical data on commercial exploitation of sharks, dating from 1935. To this pioneer work should be added the one by Angelescu (unpublished, c. 1954), in which the functioning of a small coastal shark fishery in Monte Hermoso is described (Fig. 1), on the base of the tope or school shark, *Galeorhinus galeus*.

Partly because of zoogeographic factors, and also because of reasons of human history and demography, the traditional fisheries in Argentina were in the south-center of the Buenos Aires province and north of Patagonia. From South to North, the main fishing ports towards the middle of the ‘50 were Rawson, Patagones, Puerto Quequén and Mar del Plata (Fig. 1).

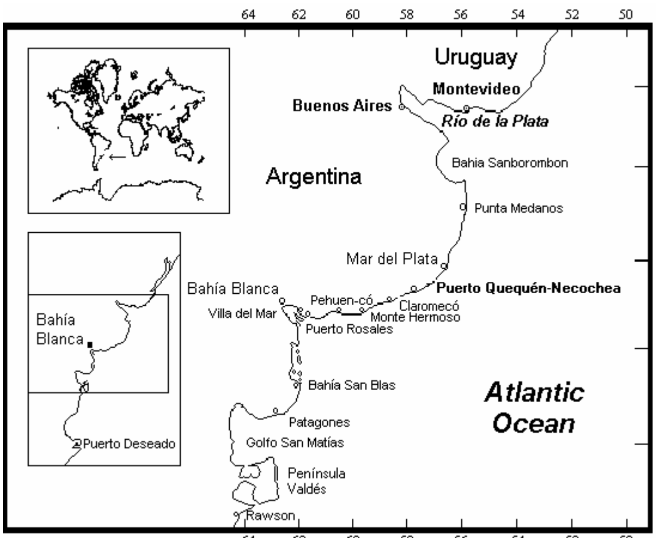


Figure 1. South West Atlantic Ocean from Uruguay to North Patagonia. Principal fishing ports for sharks are indicated.

Although the statistics of landings of Chondrichthyans began to be taken in Argentina towards the end of the ’20 of the XX century, it was only during World War II that shark fishing became perceptible. In Figure 2, data of 70 years of chondrichthyan landings in Argentina are shown.

The first impulse for shark fishing about the beginning of the ‘40 of the XX century was due to the need to replace the codfish and stockfish, which up to that time had been imported, mainly from Norway (Siccardi, 1950). Shark flesh was salted down, but the "codfish" ("bacalao") thus obtained was not of good quality, since not enough drying time was allowed, due to imperious need of replacing the imported produce. Besides, salt of national origin was of poor quality.

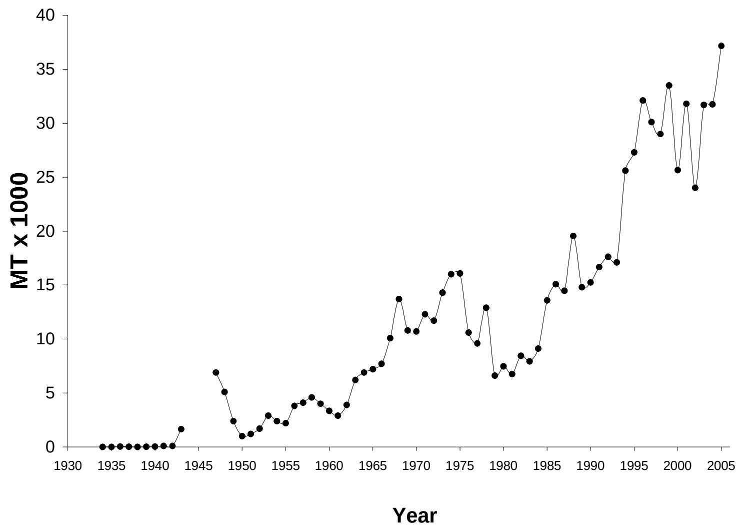


Figure 2. Declared landings of Chondrichthyes in Argentina. Period 1934–2005.

Siccardi (1950) adds that there was an unsuccessful attempt to use the calcine gristle for the manufacture of buttons. Afterwards, in 1943, production of liver oil began; this was obtained mainly from "cazón", *G. galeus*. In the same year, according to the author, 45 factories appeared as registered for the elaboration of this produce in the Ministerio de Agricultura de la Nación (National Ministry for Agriculture). The first country to which liver oil was exported was U.S.A.; afterwards, there were sales to UK, Italy, Sweden, Switzerland, France, and some Latin-American countries.

It was only towards the end of the ‘80s of the XX century that the problem of shark fishing was again considered (Corcuera & Chiaramonte, 1992); the first detailed information on functioning and calculations of Catch per Unit Effort (CPUE) for a shark fishery in Argentina was then obtained, as well as an estimation of the economic importance of the fisheries.

It is known that in argentine waters are found about 35 species of sharks (Menni, 1986), 34 of batoids (Argentina–Uruguay waters, Pequeño & Lamilla, 1993), and a single one of Holocephali; however, only three species of shark are object of directed fishing: the smooth hound, *Mustelus schmitti*, the tope shark or soup fin shark, *G. galeus* and the copper shark, *Carcharhinus brachyurus*. Other species of chondrichthyans with commercial importance as bycatch are the angel sharks, *Squatina* spp., the sand tiger shark, *Carcharias taurus*, the cockfish, *Callorhinchus callorhynchus*, and the batoids, with several species.

Buenos Aires province coastal waters skate community

It is no clear if the process of replacement is occurring in the coastal waters of the Buenos Aires Province, Argentina, because fishing pressure includes small no commercial species of skates that compound the most important group discarded (Tamini *et al*., 2006). From 1996 until today the commercial fishery of skates had raised a similar level of capture which carried on the commercial skates of the North Sea and North Atlantic to extinction.

In Argentine waters, many of the landings of elasmobranches are from fisheries targeting other species. In addition, the official statistic of catches lumps species into categories such as "skates and rays". In these conditions any plan of conservation and management becomes impossible.

PROJECT AIMS AND OBJECTIVES

The exploitation of elasmobranchs in Argentina reached the same levels that conducted some species to the extinction in other fisheries around the world. Although some species show strong evidences of declines (school shark, sand-tiger shark, copper shark, and some species of skates), few and soft actions were adopted by the national fisheries authorities in order to prevent the same catastrophes in Argentine seas. Even so, the mortality of elasmobranchs in bottom trawl gear is species-specific and it has not been estimated until today. So, differences in the survivorship were not evaluated in a conservation approach.

In the Puerto Quequén coastal bottom trawl fishery at least 23 chondrichthyan species were identified, from which 14 are commercial species (Tamini, 2001). Differences in survivorship of the commercial species could be use as a management tool to mitigate the fish mortality by bottom trawlers. Since mature males and females specimens of elasmobranch are easy to recognize, species with medium to high survivorship could be protected by a ban for reproductive females. This ban needs some other tools to be successful (e.g. an educational plan for the fishery community). This conservation tool helps to stop the depletion of the species of elasmobranchs threatened by the over-fishing, sets a seed for the development of a conservation plan for elasmobranchs in Argentina and works in order to transform coastal fisheries into a sustainable activity for the conservation of both fish and fishers. Surveys onboard the commercial coastal fleet at Puerto Quequén, allow us to estimate the figures of fatalities and survivors in elasmobranchs captured by the bottom trawlers. In the case of survivors we estimate the real chances of the fishes to survive. Based in this result we make a management recommendation to the national and local authorities to mitigate the fishing mortality of the reproductive specimens.

PROJECT IMPLEMENTATION

Methodology of the scientific activities

Onboard work

The scientific activities were conducted onboard the Puerto Quequén (Fig. 1) bottom trawlers F/V "Punta Mogotes" and F/V "Volador". Each fish trip lasted 48–108 hours, and during this time period a total of 12–24 tows were made. The tows were ~2 hours long and conducted at a towing speed of 2–3 knots over the ground in waters 35–55 meters depth. Data were collected seasonally by on board observers during 6 trips (75 tows) between November 2004 and February 2006 and samples of capture were obtained in only 47 tows. Random sampling was not attempted. We decided to work with all available hauls, since observers had no option to choose in which commercial vessel or trip to work on, as well as which haul to sample on. The data of each tow were registered (date, latitude, longitude, tow speed and depth).

Onboard work comprised two phases or different kinds of activities: a) one observational and b) other experimental.

Figure 3. The crew opens the footrope of the net and the catch is released on the deck.

a) The observational phase comprises the identification of each species of elasmobranch from each haul. We registered the time spent between the opening of the footrope of the net onboard by the crew (and the release of the catch on the deck; Fig. 3) and the selection process of the capture by the crew (commercial and discard specimens) which invariably involved the crew walking among and over many fish (Fig. 4).

Figure 4. Jorge Pérez observes the selection process of the capture by the crew (commercial and discard specimens).

During this process the identities and numbers of the chondrichthyan species were recorded. Simultaneously, the fishes were assigned according to three major categories (*Conditions*) of the *stamina index* (modified from Laptikhovsky, 2004; Fig. 5). The same categories were applied in the start of each experiment in the experimental phase.

Figure 5. The observational process of assign the *stamina index* to each fish.

The modified categories are:

Condition 1– Alive, flapping wings or with lateral and strong movements of the body.

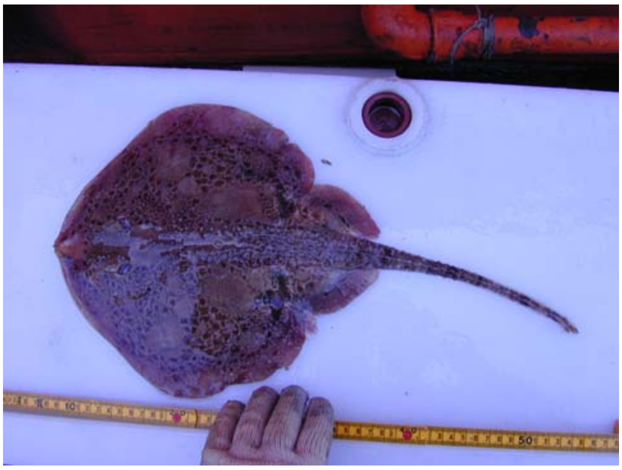
Condition 2– Immobile, but alive, move their spiracles or gill slits regularly and reacting to irritation.

Condition 3– Dead. Paralyzed, body stiffened.

Figure 6. Tanks were secured inside the forward deck.

At the same time, other observer randomly removed some specimen of each species in order to lay it into two tanks, which were secured inside the forward deck and were supplied with a constant flow of fresh seawater (Fig. 6).

b) These fishes were part of the second "experimental" phase. In this phase, each specimen was observed once each 10 minute during the first half hour, and then once each 30 minutes until 2–5 hours since the beginning of the experiment. In each observation until the fish was released to the sea or returned to the crew,



one category of the *stamina index* was assigned. After this, each specimen was sexed and the body length or disc width was measured to the nearest centimetre (Fig. 7).

Figure 7. A female of *Psammobatis bergi* during the process of measure.

Results

A total of 1,768 specimens of elasmobranch fishes were identified during the study. These fishes were classified into 10 families, 18 known species and one new species[1] (Table 1). The three most common species which comprises the 80% of the sample were *Sympterygia bonapartii*, *Rioraja agassizi* and *Squatina punctata*.

Table 1. Status, number, and percentage number of species in the catch from 47 commercial bottom trawls off Puerto Quequén.

TAXON	STATUS	COMMON NAME	NUMBER	% NUMBER
BATOIDS				
Arhynchobatidae				
Atlantoraja castelnaui	C	painted skate	61	3.45
Atlantoraja cyclophora	C	circle skate	114	6.45
Psammobatis bergi	B	sand skate	14	0.79
Psammobatis extenta	B	sand skate	4	0.23
Rioraja agassizi	C	smooth skate	366	20.70
Sympterygia acuta	C	acute skate	55	3.11
Sympterygia bonapartii	C	marble skate	772	43.67
Myliobatidae				
Myliobatis goodei	B	eagle ray	4	0.20
Rajidae				
Dipturus chilensis	C	bignose skate	10	0.60
Rhinobatidae				
Zapteryx brevirostris	B	guitarfish	9	0.50
Torpedinidae				
Discopyge tschudii	B	electric ray	19	1.10
Sp. nov.	B	electric ray	2	0.10
SHARKS				
Lamnidae				
Carcharias taurus	C	sandbar shark	1	0.05
Hexanchidae				
Notorynchus cepedianus	C	spotted sevengill shark	1	0.05
Squalidae				
Squalus acanthias	B	spinny dogfish	1	0.05
Squatinidae				
Squatina occulta	C	angelshark	1	0.05
Squatina punctata	C	angelshark	277	15.70
Triakidae				
Galeorhinus galeus	C	tope shark	5	0.30
Mustelus schmitti	C	narrownose smoothound	52	2.95

The frequencies of the *stamina index* of the specimens for the most frequent species in the samples were plotted (Fig. 8). This figure allows us to determine that five of the eleven species examined appear to be in trouble: more than 50% of the

[1] The new *taxon* will be described by Dr. Roberto Menni and Dr. Mirta García from La Plata Museum.

specimens were in not a good condition when they were released on deck (*Atlantoraja castelnaui, Mustelus schmitti, Psammobatis bergi, Sympterygia acuta* and *Zapteryx brevirostris*).

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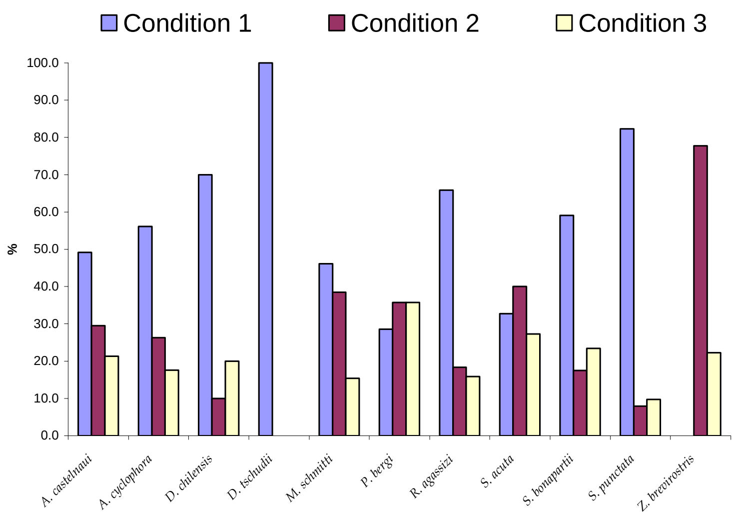

Figure 8. The *stamina index* assigned to each species according to three major categories (Condition 1, Condition 2 and Condition 3; see the section *Methodology of the scientific activities*).

The second or so called "experimental" phase (Fig. 9a & 9b) involves twelve species with a total of 95 specimens observed. Eight of these species exhibit a percentage of survival rates above 50% (Table 2). The skate *Atlantoraja cyclophora* showed the worst survival rate whilst the electric ray *Dicopyge tschudii* and the angelshark *Squatina punctata* exhibit the best performance (Table 2).

Figure 9a & 9b. On the right, the student Matías Urcola examined some specimens of electric rays during the experimental phase onboard the *F/V Punta Mogotes* in order to assign the *stamina index* according to three major categories (Condition 1, Condition 2 and Condition 3; see the section *Methodology of the scientific activities*). Below, Jorge Perez supplied with fresh seawater the bins during other sailing onboard the same ship.

Table 2. Status, number, and percentage number of species in the sample of the experimental phase from 47 hauls of commercial bottom trawls off Puerto Quequén.

	n	TL (mm)	Time spent in fish bin (min)	Survival rate (%)
Atlantoraja castelnaui	8	520-735	15-210	88
Atlantoraja cyclophora	7	350-610	30-210	29
Dicopyge tschudii	7	285-460	15-30	100
Galeorhinus galeus	2	800-820	60-210	50
Mustelus schmitti	2	420-540	15-30	0
Psammobatis bergi	4	450-475	15-30	75
Psammobatis extenta	1	300	30	0
Rioraja agassizi	20	400-660	15-180	60
Squatina punctata	5	250-660	15-30	100
Sympterygia acuta	5	520-630	15-270	60
Sympterygia bonapartii	26	400-760	15-120	88
Zapteryx brevirostris	8	495-630	15-30	100
Total	**95**			

EDUCATIONAL PLAN

Education goals

- To generate local and regional consciousness about the peril of chondrichtyan fishes at the argentine coast, and the requirements for the conservation of the species.
- To provide local teachers, through educational activities, information and tools that allow them to improve their work with the local pupils.

Targets of the educational work

Environmental education activities were addressed to Necochea and neighboring community members, more specifically to fishermen, educators and community leaders. Three different kinds of audience will be distinguished in order to make the educational activity:

- Community leaders: to bring up local leaders that will be able to continue with the educational activities about the environmental in a long term.

- Teachers and indirectly girls and boys, who attend schools of the project area: to work on subjects about environmental care, address specials emphasis in topics related with this project.
- Fishermen: to develop and work with topics referred to the suitable use of fishing gears that are used in order to decrease the impact on elasmobranch populations.

Workshop for teachers, community leaders and fishermen

On March 2005, we made a trip to Necochea to present the educational team to different actors of the community. Our objective was to make a diagnostic evaluation to detect their appreciation about the local coastal commercial fishery and the impact on the marine ecosystem and to begin to design of the educative plan for activities with teachers, community leaders and fishermen. To accomplish this, we organized several meetings and interviews with the above mentioned actors, and we analyzed with them the opportunity of developing activities together.

Some people we met were:

- Lic. Marcela Mastrocola, Pro Secretaria General of the Unidad de Enseñanza Universitaria Quequén, Universidad Nacional del Centro de la Provincia de Buenos Aires.
- Eduardo Catalisano, school teacher at Puerto Quequén.
- Luis Nogueira, Technician of the CONICET (Consejo de Investigaciones Científicas y Técnicas), who works at the Estación Hidrobiológica de Puerto Quequén (which belongs to the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia").
- Ernesto Klocker head of the Prefectura Naval Argentina–Puerto Quequén (PNA is the police for the Marine and Freshwater matters).
- The skippers and crew of the *F/V Punta Mogotes*, *F/V Volador*, *F/V Neptunia* and *F/V Virgen de las Nieves*.

As a result of the interviews, we decided to develop a Workshop called "Pesca costera: ¿qué, cómo y cuánto se pesca?" (Coastal fishery: what, how and how many is fished?). We also distinguished the major themes to include in the educative program:

- Sort of fisheries
- Fishing gears
- Invertebrates, Chondrichthyes, Bonefishes, Turtles, Seabirds, Marine mammals and their relationship with the fishery
- Incidental captures
- Overfishing, bycatch and mitigation tools
- The argentine framework for fisheries and the process from the ship to the market of the fish products
- The Puerto Quequén coastal fishery, and the life strategies of the fishermen in the locality

Didactic material and panellists

We produce specific material which summarizes the main contents deals during the workshop, in order to facilitate the comprehension during it and to provide material for further consults. Each participant was provided with this material (minimal contents in a hard copy and a more complete CD–ROM) for further searches. The persons who contribute to the workshop were:

- **Chiaramonte**, Gustavo E. (biologist; head of this RSG Project; workshop coordinator)
- **González Carman**, Victoria (undergraduate biologist; member of *Regional Program of Research and Conservation of Marine Turtles of Argentina*)
- **Iwaszkiw**, Juan (biologist; former Director for Fisheries of Buenos Aires province)
- **Nogueira**, José Luis (technician; Estación Hidrobiológica de Puerto Quequén)
- **Pastorino**, Guido (biologist; Academic Secretariat of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia")

- **Perez**, Jorge E. (biologist; team member)
- **Prosdocimi**, Laura (biologist; member of *Regional Program of Research and Conservation of Marine Turtles of Argentina*)
- **Retta**, Susana (biologist. Doctorate student at Mar del Plata Univ.; Fig. 10)
- **Rispoli**, Florencia (anthropologist; doctorate student at Mar del Plata University)
- **Tamini**, Leandro Luis (biologist; team member; workshop coordinator)

Figure 10. The ichthyologist Susana Retta illustrates about the bonefishes captured by the Puerto Quequén coastal fleet.

Programme and activities

The workshop was developing during the evening of May 17, 18 and 19 at the *Unidad de Enseñanza Universitaria Quequén*, *Universidad Nacional del Centro de la Provincia de Buenos Aires* with a total of 25 attendants. These activities lasted 12 hours. Below is summarized the detailed programme:

1st Day:

Unit 1:	Sort of fisheries (Gustavo–Leandro; Fig. 11)
	Fishing gears (Jorge–Gustavo–Leandro)
Unit 2:	Invertebrates (Guido)
Unit 3:	Invertebrates (Guido)
Unit 4:	Cartilaginous fishes – Target species (Gustavo)

2nd Day:

Unit 5:	Bonefishes (Susana)
Unit 6:	Marine turtles – Incidental captures (Victoria–Laura)
Unit 7:	Seabirds – incidental captures (Leandro)
Unit 8:	Marine mammals – incidental captures (Jorge)

3rd Day:

Unit 9:	From the ship to the market (Juan; Fig. 12)
Unit 10:	The argentine framework for fisheries (Juan)
Unit 11:	Coastal fleet operation in Puerto Quequén (Luis)

Life strategies of the fishermen home's (Florencia)

Unit 12: Overfishing, bycatch and mitigation tools (Gustavo-Leandro-Jorge)

Figure 11. I discuss with one attendant about the trawlers of the Puerto Quequén coastal fleet.

The workshop was addressed to three different kinds of public: institutional and business representatives, teachers and fishermen. This composition of the audience allowed us to exchange their experiences and knowledge with us and to enrich our work.

Figure 12. Juan explains the needs of the fish meet in order to commercialize it.

The workshop received public diffusion through the local newspaper EcosDiarios, which summarised the activity in the Sunday edition of May 21st (Fig. 13).

Ecos Diarios | Página 8 - La ciudad — Domingo 21 de mayo de 2006

Características de la pesca costera en el Sur provincial

Se desarrollaron tres jornadas para docentes y público en general

• Coordinado por el Museo Bernardino Rivadavia • Exposición sobre distintos aspectos

La pesca costera fue el tema del desarrollo de un curso intensivo de tres días que se llevó a cabo en la Unidad de Enseñanza Universitaria de Quequén, dependiente de la Universidad Nacional del Centro de la Provincia de Buenos Aires (Unicen).

El encuentro denominado "¿Qué, cómo y cuánto se pesca?" fue coordinado por especialistas del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia".

Durante su desarrollo se brindó información sobre las características de la pesca costera en el Sur de la Provincia de Buenos Aires, a la vez que se realizó una pormenorizada exposición sobre los aspectos metodológicos, ecológicos, comerciales e históricos de dicha actividad.

Los principales temas, que integraron los tres módulos de trabajo fueron: tipos de pesquerías, artes de pesca, composición de las capturas, captura incidental de aves, tortugas y mamíferos marinos, descarte pesquero, sobrepesca, circuitos de comercialización, salubridad, marco regulatorio, desembarques y características y estrategias familiares en los hogares de los pescadores.

Conforme. Se mostró el especialista Leandro Tamini.

El objetivo

Consultado acerca de la realización del curso, Leandro Luis Tamini, especialista del Museo Bernardino Rivadavia, detalló que "el objetivo era que la persona que viniera al curso tuviera una idea integral de lo que es la pesca costera en Quequén y el Sur de la Provincia de Buenos Aires, desde captura, hasta legislación y sanidad de los productos pesqueros".

Agregó que "si bien hacemos hincapié en los docentes porque ellos son los multiplicadores de este conocimiento, el curso está abierto a toda la comunidad".

Las jornadas de trabajo, que se extendieron desde las 18 y hasta las 22, contaron con la presencia de unas 15 personas, número que colmó las expectativas de los organizadores, ya que "preferimos la participación de 15 interesados y no de 50 desinteresados", dijo Tamini.

Incluso, en algunos de los encuentros se observó un importante intercambio entre los alumnos y los docentes, al punto que no pudieron desarrollarse todos los temas previstos para ese día. "Quienes vinieron ya cuentan con información sobre el tema, por lo que las preguntas fueron elevadas", dijo el disertante.

Búsqueda de familiares

Un grupo de familiares de apellido de la Canal está tratando de recomponer la historia de su familia, una de las más antiguas de la Argentina.

A través de este medio pretende comunicarse con todos aquellos que deseen compartir una reunión a nivel nacional de los descendientes de este apellido.

Por tal motivo, los interesados deben comunicarse a la siguiente dirección de e mail: gdlcanal@intramed.net.ar

DE CLAUDIA TERUGGI

Figure 13. Media article with the results of the workshop .

Other Outputs

We exhibit this poster at the Society for the Conservation Biology meeting (San Jose, California; 24–28 June 2006).

SURVIVAL RATES FOR ELASMOBRANCHES CAPTURED BY A MULTISPECIES TRAWL FISHERY OFF ARGENTINA

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Over-exploitation of elasmobranches is matter of concern around the world. Waters off Buenos Aires Province (BAP), Argentina, are subject to a multispecies bottom trawl fishery. At Puerto Quequén (BAP), elasmobranches are the main group of fished landed. Return elasmobranches to the sea by the trawl vessels has been proposed as a mitigation action, but survival of elasmobranches after being discarded was not investigated. The aim of this study is investigate the survival rate of elasmobranches captured by the trawl fishery.

The research was conducted onboard the trawler *Punta Mogotes* during austral winter and spring 2005. A total of 87 elasmobranches were randomly sampled from the deck and put into a bin that contained running seawater. A stamina index was assigned according three categories: a) alive, b) immobile but reacting to irritation and c) dead, body stiffened but may resume breathing after being paced in seawater.

	n	TL (mm)	Time spent in fish bin (min)	Survival rate (%)
Atlantoraja castelnaui	7	520-700	15-210	71
Atlantoraja cyclophora	6	350-610	30-210	33
Dicopyge tschudii	7	285-460	15-30	100
Galeorhinus galeus	2	800-820	60-210	50
Mustelus schmitti	2	420-540	15-30	0
Psammobatis bergi	2	450-475	15-30	100
Psammobatis extenta	1	300	30	0
Rioraja agassizi	20	400-660	15-180	60
Squatina punctata	5	250-660	15-30	100
Sympterygia acuta	5	520-630	15-270	60
Sympterygia bonapartii	24	400-760	15-120	92
Zapteryx brevirostris	6	495-630	15-30	100
Total	**87**			

Twelve species were sampled and the survival rate of most of them is quite important. Despite this, survival is not guaranteed after discard because the elasmobranches may be consumed or mortally injured by bottom scavengers during the recovery time which appears to be about 15–120 min.

Highlights & Conservation Problems

We assessed two sources of concerns about the survivorship chances of sharks, skates and rays:

a. the condition of the fish when they are released on the deck
b. the fish rate of recovery

We could state that each source of concerns is species dependant. The angel sharks and electric rays showed good *stamina index* on deck and also good rate of recovery. The commercial species of skates exhibit middle to good rate of recovery (with the exception of *A. cyclophora*), whilst the shark *M. schmitti* exhibit a bad performance in both stages of the assessment.

We also identified two other variables (a] the time of trawling; b] the time spent by skates on deck before they are released to the sea) that could influence the survival rate of the elasmobranches. These variables will be tested in deeper during the process of writing the scientific paper during the next months.

Recommendations

The fieldwork of the project onboard the ships and our previous knowledge allow us to realize that only three ways of action should be recommended:

a. the urgent need of apply the International Plan of Action for the Management of Fishing Capacity, in order to diminish the coastal fishing pressure over the elasmobranch species
b. the implementation of a program with the crews of coastal fleet to encourage them to cooperate with the conservation of the species, recognizing the threatened species
c. the implementation of a program with the crews of coastal fleet in order to release the individuals of threatened species to the sea according with our results of the *Stamina Index*

Since the coastal fishery is a multispecies fishery, and at least 19 species of elasmobranches occur, other management tools such as ban for species or group of species, as well as the implementation of closure areas, are not recommendable.

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EVALUACI6N DE LA SUPERVIVENCIA DE ELASMOBRANQUIOS CAPTURADOS POR ARRASTREROS DE FONDO

por
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SUMMARY

Evaluation of survival of elasmobranchs caught by bottom trawlers. Survival of elasmobranchs to the bottom trawl fishery at Puerto Quequen was evaluated. Each individual caught was assigned one of the three categories (condition) that compose the Stamina Index: 1) Alive, flapping wings and moving body; 2) Immobile but alive, normal movement of spiracles and gills, reacting to irritation; 3) Dead, paralyzed, stiffened body. A total of 1,768 individuals belonging to 10 families and 19 species were identified. The percentage of specimens released dead on deck (Condition 3) amounted to 19,2%. Of the 11 species that most contributed to the sample *Atlantoraja castelnaui*, *Mustelus schmitti*, *Psammobatis bergi*, *Sympterygia acuta* and *Zapteryx brevirostris*, highly vulnerable, showed over 50% of the individuals in condition 2 or 3. In recovery experiments skate *Atlantoraja cyclophora* had the lowest responsive rate; electric ray *Discopyge tschudii* and angel shark *Squatina guggenheim* exhibit the highest.

RESUMEN

Se evalu6 la supervivencia de elasmobranquios a la pesca comercial de arrastre de fondo en el area de Puerto Quequen. A cada ejemplar capturado se le asign6 una de las tres categorlas (condici6n) que conforman el fndice de Resistencia: 1) Vivo, con movimiento de aletas y cuerpo; 2) lnm6vil pero vivo, apertura regular de Ios espiraculos y las aberturas branquiales, con reacci6n a la irritaci6n; 3) Muerto, paralizado, cuerpo rigido. Se identific6 un total de 1.768 ejemplares pertenecientes a 10 familias y 19 especies. El porcentaje de individuos liberado muerto en cubierta (Condici6n 3) fue del 19,2%. De las 11 especies mejor representadas en la muestra *Atlantoraja castelnaui*, *Mustelus schmitti*, *Psammobatis bergi*, *Sympterygia acuta* y *Zapteryx brevirostris*, altamente vulnerables, mostraron mas del 50% de Ios individuos en Condici6n 2 6 3. En los experimentos de recuperaci6n la raya *Atlantoraja cyclophora* tuvo la tasa de respuesta mas baja; la raya electrica *Discopyge tschudii* y el pez angel *Squatina guggenheim* exhibieron la mas alta.

Keywords: Survival, elasmobranchs, bottom trawl fishery.
Palabras clave: supervivencia, elasmobranquios, pesca de arrastre de fondo.

INTRODUCCI6N

En muchas pesquerias,incluidas las de arrastre de fondo,un gran numero de especies que no son objetivo de las mismas son capturadas junto con las especies blanco (Hall, 1996). A pesar de las reglamentaciones, las capturas no deseadas son habitualmente descartadas, perdiendose asf parte del recurso *y* generando consecuencias que todavia no han sido convenientemente evaluadas sobre las poblaciones,lascadenas tr6ficas ylosecosistemas.

La supervivencia de las especies objeto de descarte es una de las consecuencias de esta practica quesedebe evaluar para poder tomar medidas demitigaci6n que permitan un uso racional delosrecursos pesqueros. Se sabe que en elasmobranquios la supervivencia a la pesca de arrastre (o la mortalidad asociada) es especie-espedfica (Fennessy, 1994) yen losultimos afios seha tratado de evaluar para varias especies en algunas pesquerfas (entre otros, Fennessy, 1994; Laptikhovsky, 2004; Revill *et al.*, 2005; Enever *etal.*,2009).

Sohre la base del particular descarte de batoideos por parte de la flota costera que opera desde Puerto Quequen (Tamini *etal.*,2006),*y* laincidencia de estetipo de flotaen eltotal delas desembarques de condrictios en Argentina, el presente trabajo pretende evaluar el estado de condici6n (fndice de Resistencia) de los condrictios capturados una vez que llegan a bordo de lasbarcos comerciales de la flota costera.

MATERIALES YMETODOS

Losestudios sellevaron a cabo a bordo de las B/P "Punta Mogotes"y B/P "Volador" con asiento en Puerto Quequen, Necochea, Provincia de Buenos Aires. Cada viaje depesca dur6 entre 48y108 horas, y la cantidad de lances por viaje vari6 entre 12 y 24. Cada lance tuvo un promedio de duraci6n de 2 horas, a una velocidad de arrastre de 2-3 nudos y en profundidades que variaron entre 35 y 55 metros. Los datos fueron colectados estacionalmente par observadores cientfficos a bordo en 6 viajes de pesca (47 lances) efectuados entre noviembre de 2004 y febrero de 2006. Debido a las dificultades logisticas del trabajo a bordo de barcos comerciales (las observadores no podfan elegir en que barco embarcar, ni cuales lances registrar) no se intent6 realizar un muestreo al azar.Se decidi6 trabajar con todos los lances disponibles, de las cuales se registraron las datos correspondientes a fecha, latitud, longitud, velocidad de arrastre *y* profundidad.

El trabajo a bordo comprendi6 dos fases con actividades distintas: a) observaci6n y b) experimentaci6n. Para cada lance,la fase de observaci6n consisti6 enla identificaci6n a nivel especifico de las elasmobranquios capturados, el registro del tiempo transcurrido entre la apertura del capo de Ia red sabre la cubierta del barco y el inicio del proceso de selecci6n de la captura par la tripulaci6n (espedmenes comerciales y de descarte). Durante el proceso de identificaci6n se registr6 el numero de individuos de cada especie. Simultaneamente se le asign6 a cada ejemplar una de las tres categorlas (condici6n) que conforman el fndice de resistencia (modificado de Laptikhovsky, 2004). Estas categorlas fueron: 1) Vivo, con movimiento de aletas y cuerpo; 2) Inm6vil, pero vivo, apertura regular de las espiraculos y las aberturas branquiales y reaccionando sieran molestados; 3) Muerto, paralizado, cuerpo rlgido.

Para la fase experimental se tomaron al azar ejemplares vivas (condiciones 1y 2 de la fase de observaci6n) provenientes de la captura y selas coloc6 en dos hateas con suministro constante de agua de mar. Los ejemplares fueron observados y evaluados en su Tasa de Recuperaci6n cada 10 minutos durante la primera media hara ya intervalos de 30 minutos hasta un total de 2 a 5 horas. Al final de esteperiodo,se evalu6 la condici6n final de cada ejemplar, se determin6 el sexo y se midi6 la longitud total o el ancho de disco.

RESULTADOS

Fase de observad6n

Un total de 1.768 ejemplares fue identificado durante el estudio, correspondientes a 10 familias y 19 especies. Las especies mas abundantes, que conformaron el 80% de la muestra, fueron tres: *Sympterygia bonapartil Rioraja agassiziiy Squatinaguggenheim* (Tabla 1).

Tabla 1: Estatus, numero, y porcentaje en numero de las especies en la captura en 47 lances de pesca comercial de arrastre de fondo en el area de Puerto Quequen. C: comercial; D: descarte.

Table 1: Status, number and percentnge by number of the species catches by 47 tows of commercial bottom trawlers at Puerto Quequen. C: commercial; D: discard.

	TAXON	ESTATUS	NUMERO	% NUMERO
BATOIDEOS				
	Arhynchobatidae			
ACAS	*Atlantoraja castelnaui*	C	61	3,45
ACYC	*Atlantoraja cyclophora*	C	114	6,45
PBER	*Psammobatis bergi*	D	14	0,79
PEXT	*Psammobatis extenta*	D	4	0,23
RAGA	*Rioraja auassizii*	C	366	20,70
SACU	*Sympterygia acuta*	C	SS	3,11
SBON	*Sympterygia bonapartii*	C	772	43,67
	Myliobatidae			
MGOO	*Myliobatis goodei*	D	4	0,20
	Rajidae			
ZCHI	*Zearaja chilensis*	C	10	0,60
	Rhinobatidae			
ZBRE	*Zapteryx brevirostris*	D	9	0,SO
	Torpedinidae			
DTSC	*Discopyge tschudii*	D	19	1,10
	Discopyge castelloi	D	2	0,10
TIBURONES				
	Lamnidae			
CTAU	*Carcharias taurus*	C	1	0,05
	Hexanchidae			
NCEP	*Notorynchus cepedianus*	C	1	0,0S
	Squalidae			
SACA	*Squalus acanthias*	D	1	0,05
	Squatinidae			
SOCC	*Squatina occulta*	C	1	0,05
SGUG	*Squatina guggenheim*	C	277	1S,70
	Triakidae			
GGAL	*Galeorhinusgaleus*	C	S	0,30
MSCH	*Mustelus schmitti*	C	S2	2,9S

La frecuencia por especie del indice de Resistencia muestra que, para el total de individuos muestreados, el 19,2% fue liberado muerto en cubierta (Condici6n 3; Tabla 2). Asimismo, de las 11 especies que mas contribuyeron en Ia muestra, cinco *(Atlantoraja castelnaui, Mustelus schmitti, Psammobatis bergi, Sympterygia acuta* y *Zapteryx brevirostris*, Tabla 2) son altamente vulnerables a este ti.po de arte de pesca, dado que mas del 50% de Ios individuos que eran liberados en cubierta no se encontraba en buenas condiciones. (Tabla 2)

Tabla 2. fndice de Resistencia de las especies registradas en 47 lances de pesca comercial de arrastre de fondo en el area de Puerto Quequen. Ver abreviaturas en Tabla 1. Dos ejemplares de *Discopyge castelloi* no fueron considerados en elanalisis.

Table 2. Stamina index of the species catches in 47 tows of commercial bottom trawl fishery at Puerto Quequen. See Table 1 for abbreviations. Two individuals of *Discopyge castelloi* were no considered into the analysis.

Condicion	*ACAS*	*ACYC*	*CTAU*	*ZCHI*	*DTSC*	*GGAL*	*MG OO*	*MSCH*	*NCEP*
1	30	64	1	7	19	1	1	24	0
2	18	30	0	1	0	1	1	20	1
3	13	20	0	2	0	3	2	8	0
N	61	114	1	10	19	5	4	52	1

Condicion	*PBER*	*PEXT*	*RAGA*	*SACA*	*SACU*	*SBON*	*SGUG*	*SOCC*	*ZBRE*
1	4	1	241	1	18	456	228	1	0
2	5	0	67	0	22	135	22	0	7
3	5	3	58	0	15	181	27	0	2
N	14	4	366	1	55	772	277	1	9

Condici6n	*Total*	%
1	1097	62,1
2	330	18,7
3	339	19,2
N	1766	100

Faseexperimental

Esta fase comprendi6 un total de 95 ejemplares correspondientes a 12 especies. Ocho de estas mostraron un porcentaje de supervivencia mayor al 50% (Tabla 3). La *rayaAtlantoraja cyclophora* mostr6 la tasa mas baja de supervivencia, mientras que la raya electrica *Discopyge tschudii* y el pez angel *Squatina guggenheim* exhibieron Iamas alta (Tabla 3).

Tabla 3. Numero de ejemplares, rango de tallas, tiempo dentro de las bateas y Tasa de Recuperaci6n de 12 especies de peces elasmobranquios observados.
Table 3. Number of individuals, size ra111Je, time spent into the bin and recovery tax of the 12 species of elasmobranches observed.

	n	Largo total (mm)	Tiempo en batea (min)	Tasa de Recuperaci6n (%)
Atlantoraja castelnaui	8	520 -735	15-210	88
Atlantoraja cyclophora	7	350-610	30 -210	29
Discopyge tschudii	7	285-460	15-30	100
Galeorhinus galeus	2	800-820	60 -210	50
Mustelus schmitti	2	420-540	15-30	0
Psammobatis bergi	4	450 -475	15-30	75
Psammobatis extenta	1	300	30	0
Rioraja agassizii	20	400- 660	15-180	60
Squatina guggenheim	5	250- 660	15-30	100
Sympterygia acuta	S	520-630	15-270	60
Sympterygia bonapartii	26	400- 760	15-120	88
Zapteryx brevirostris	8	495- 630	15-30	100
Total	95			

DISCUSION

Se ban evaluado en este trabajo dos parametros distintos que son fuente de informaci6n para el diagn6stico deesta problematica:

a. la Condici6n en la cual el pescado Bega abordo;
b. la Tasa de Recuperaci6n de cada especie

Los resultados conftrman lo aftrmado por Fennessy (1994), acerca de que la mortalidad de elasmobranquios inducida par el arrastre (y par lo tanto la supervivencia) es especie dependiente. El (ndice de resistencia y la tasa de recuperaci6n de las elasmobranquios del area estudiada muestra la especificidad de ambos parametros. En tanto el pez angel y la raya electrica presentaron un alto porcentaje de ejemplares vivas y en buena condici6n cuando llegaban a bordo, as(como una rapida recuperaci6n dentro de las tanques, las especies de rayas comerciales exhibieron un fndice de resistencia y una tasa de recuperaci6n de regular a buena (con Ia excepci6n de A *cyclophora).* Finalmente, el gatuzo mostr6 un pobre desempeiio en el indice de resistencia y si bien la muestra fue pequeiia para el experimento de recuperaci6n, no sobrevivi6 ning1ln ejemplar (Tablas 2 y 3).

Se identiftcaron otras dos variables que pueden influir en la supervivencia y que deberfan ser convenientemente evaluadas afuturo: a) el tiempo de arrastre yb) eltiempo de Ia maniobra de calado del artedepesca, durante el cual los animales quedan sobre cubierta antes deser devueltos alagua.

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