FMAP and Pew Global Sharks Assessment – integration to OBIS

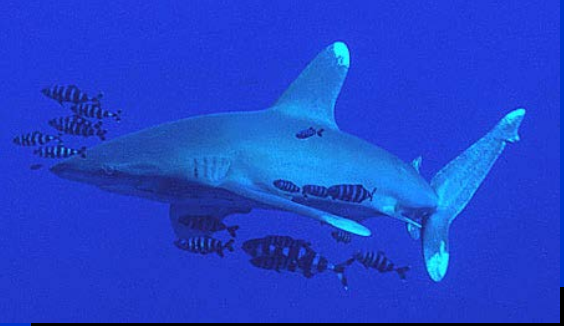
D. Ricard, R.A. Myers, L. Lucifora, F.Ferretti, J. Breen

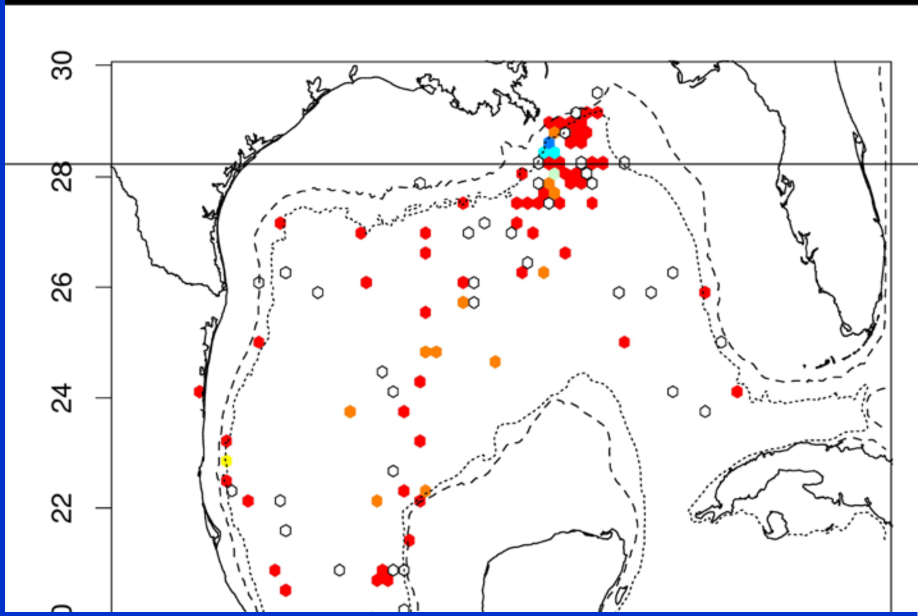
Dalhousie University, Halifax NS, Canada

What was the most common large animal (>50 Kg) in the world? (perhaps this one was)

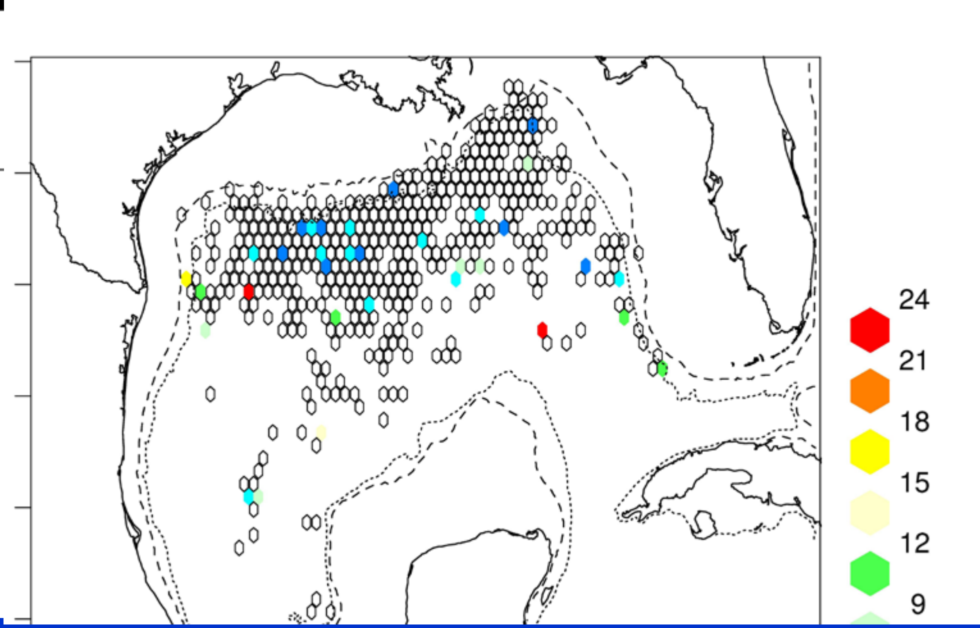
Loss of sharks in the Gulf of Mexico

300 fold decline – no one noticed





1950's



1990's

Oceanic Whitetip captures per 10,000 hooks

Baum and Myers, 2004 Ecology Letters

Circumstantial evidence of oceanic whitetip sharks being common in the Gulf of Mexico

Mapping the History of Major Maine Species

Model Relative Abundance versus Environmental Variables from Research Data

Global Environmental Data

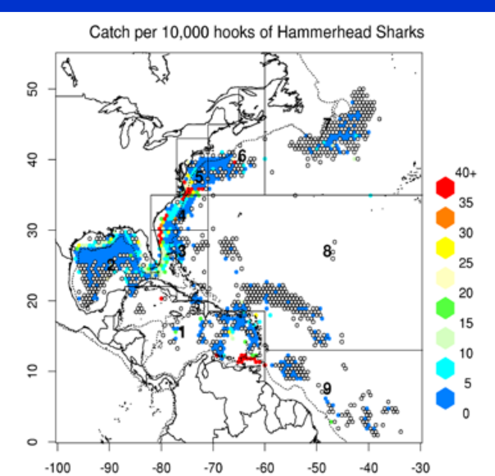
Estimated Global Patterns of Fishing Effort from FAO Data

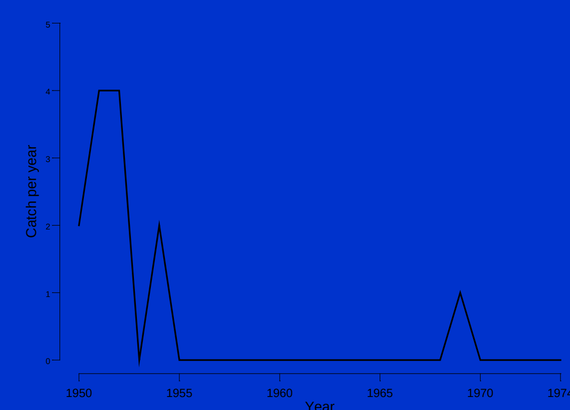
Local Shark Assessments

Predicted Global Habitat Suitability, i.e. Relative Abundance

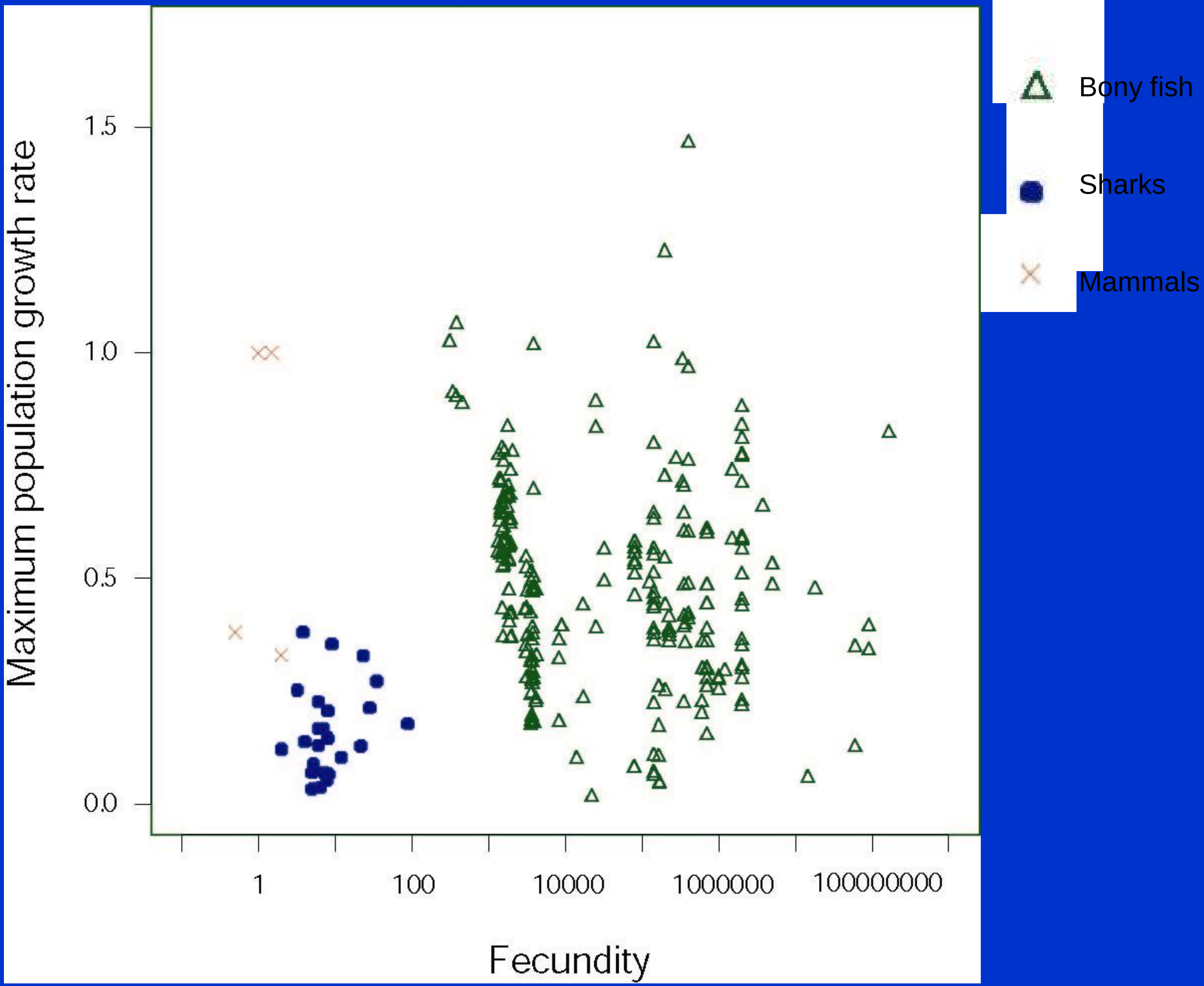
Predict Regional Abundance Trends

Estimated Absolute Abundance and Distribution for the Last Century for Major Shark Species



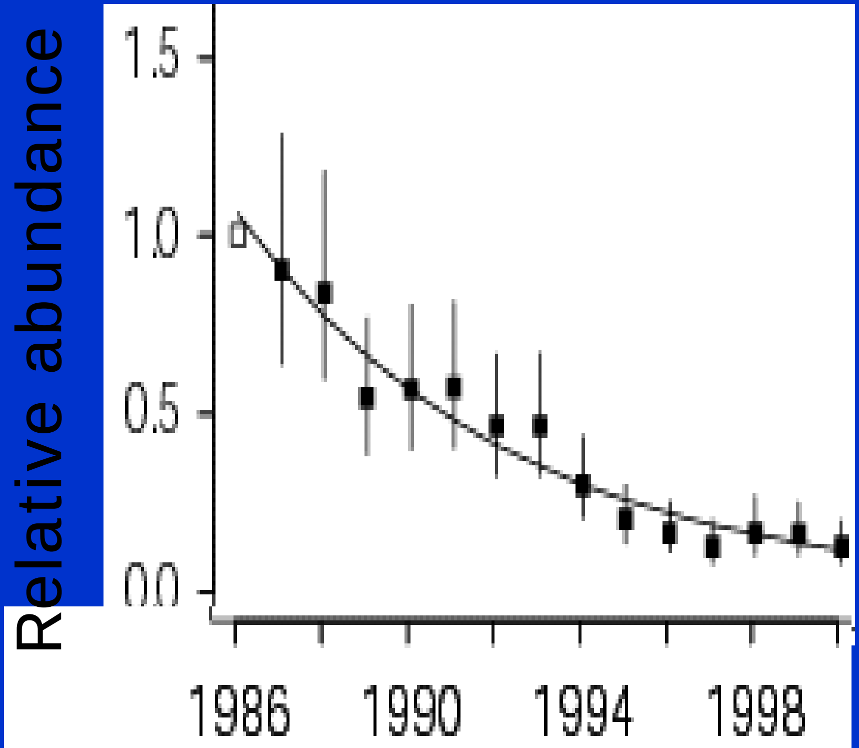


Life history of sharks…



Hammerhead sharks

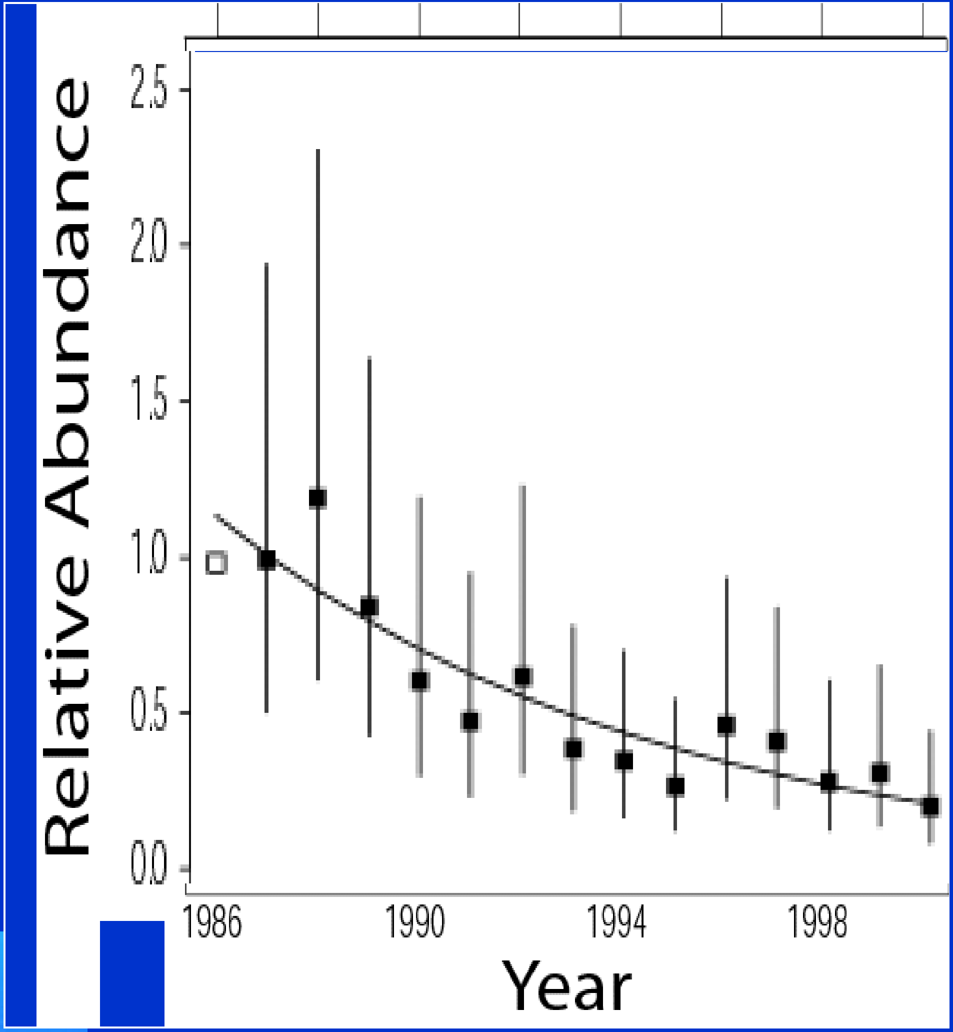
Sphyrna lewini



Science. Jan. 2003. J.K. Baum, R.A. Myers, D.G. Kehler, B. Worm, S.J. Harley, P.A. Doherty

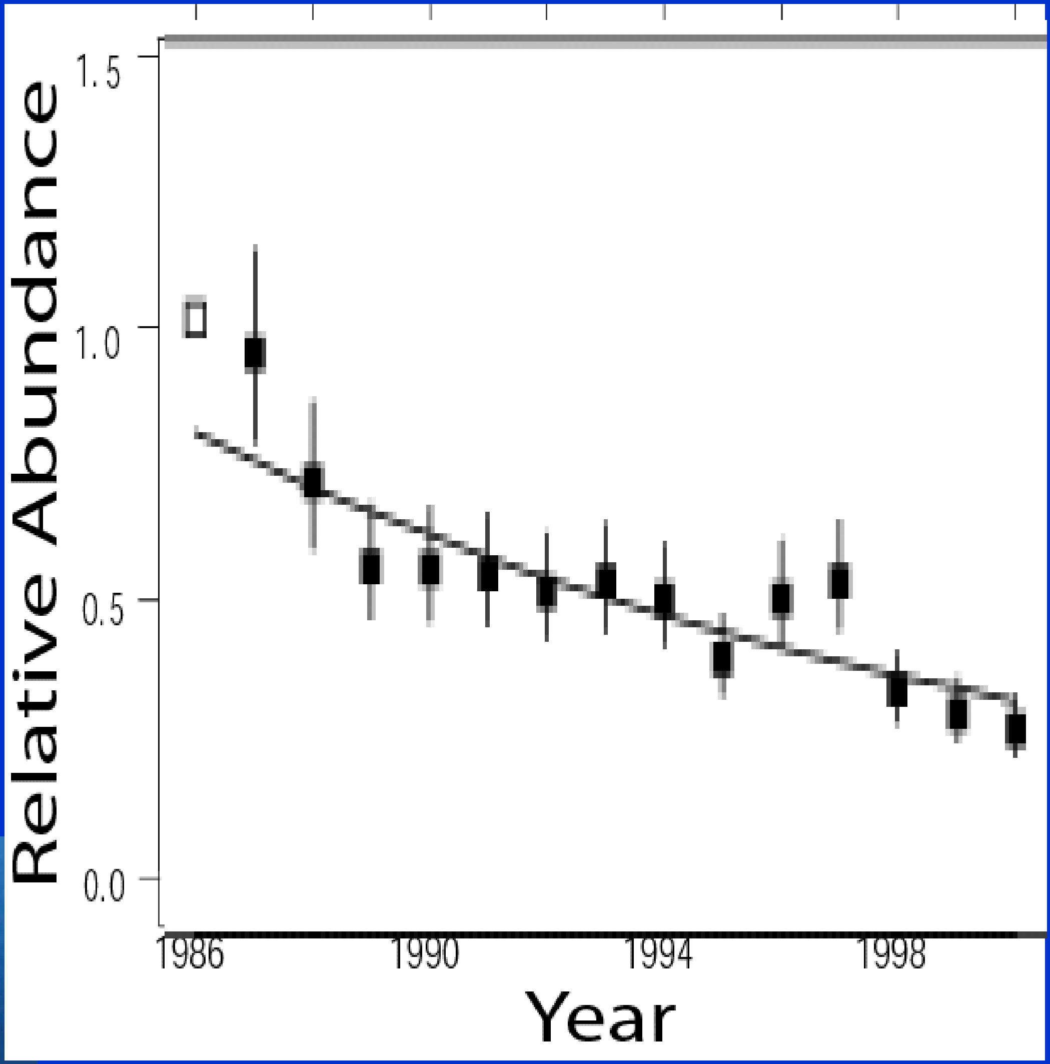
Thresher sharks

Alopias spp.

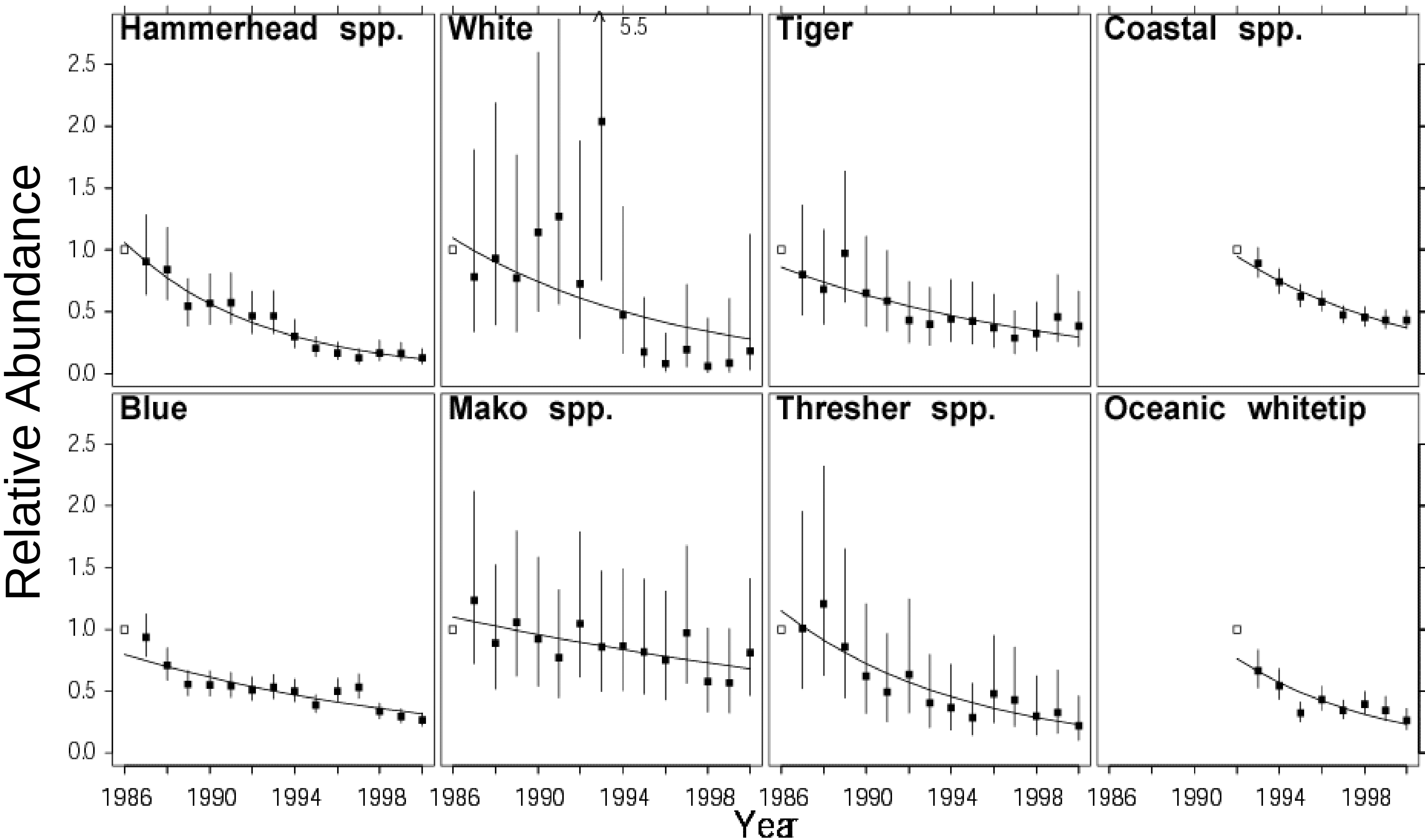


Blue sharks

Prionace glauca

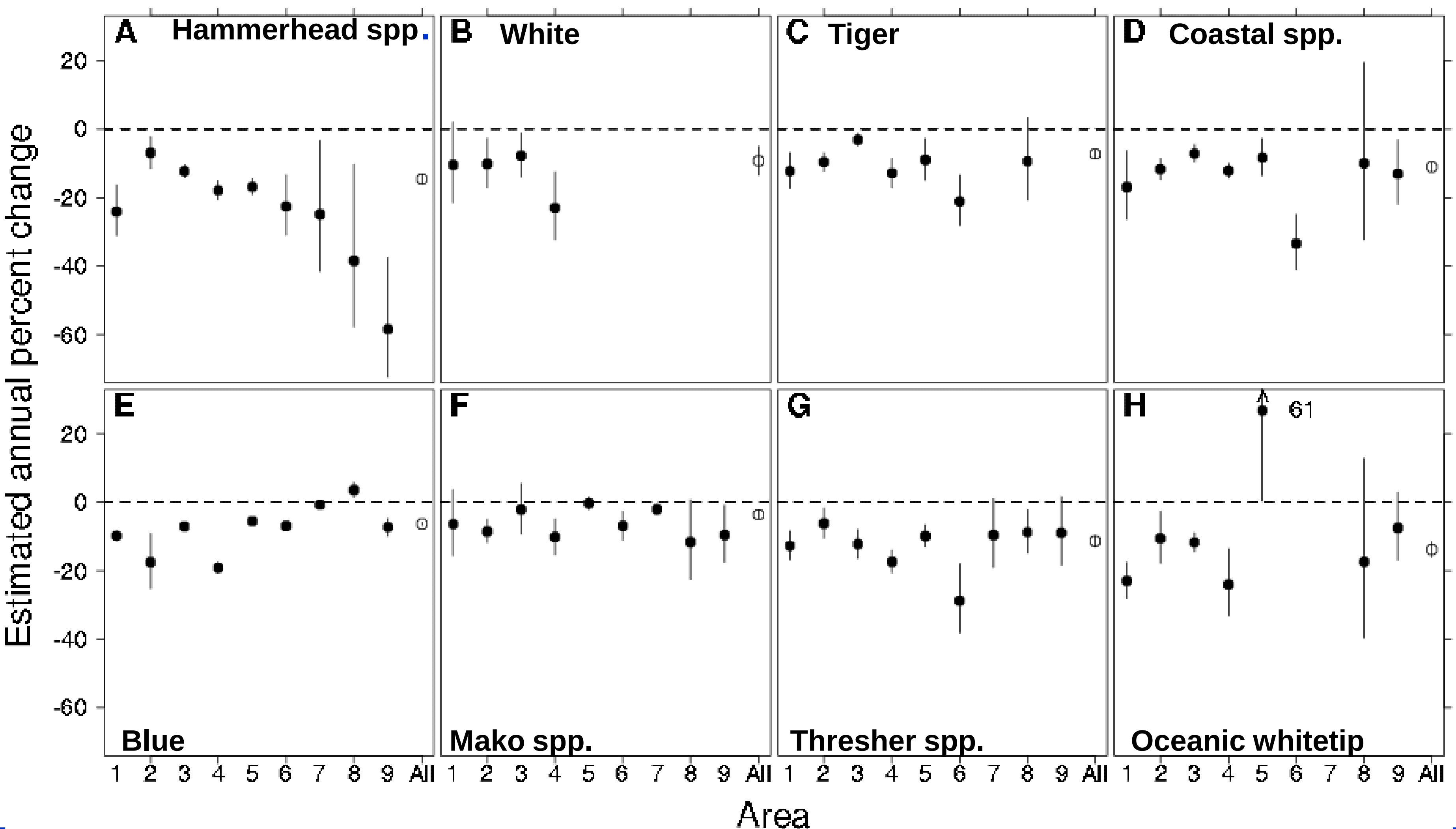


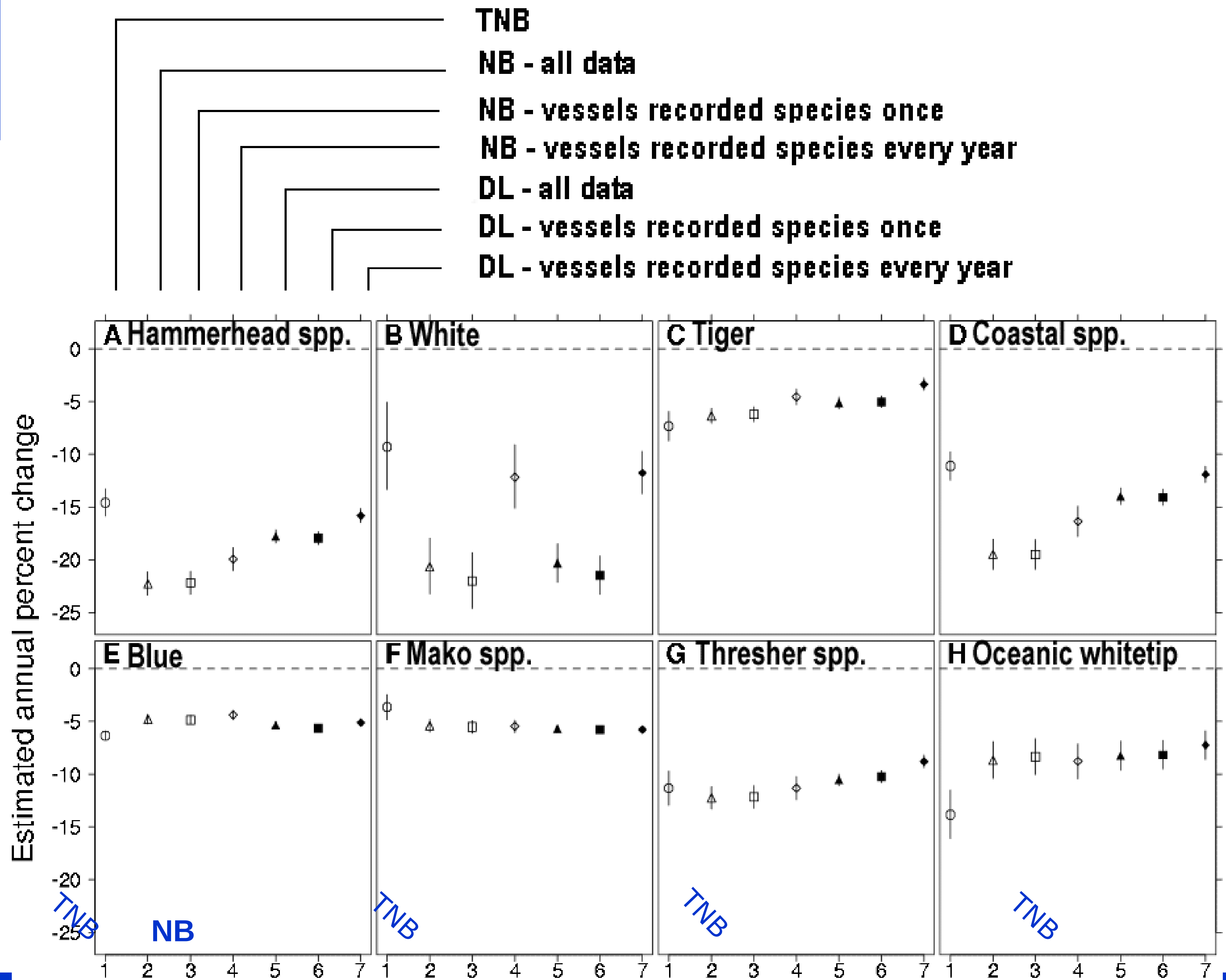
Results



Hammerhead spp.
White
5.5
Tiger
Coastal spp.
Blue
Mako spp.
Thresher spp.
Oceanic whitetip
Relative Abundance
0.0
0.5
1.0
1.5
2.0
2.5
1986
1990
1994
1998
Year

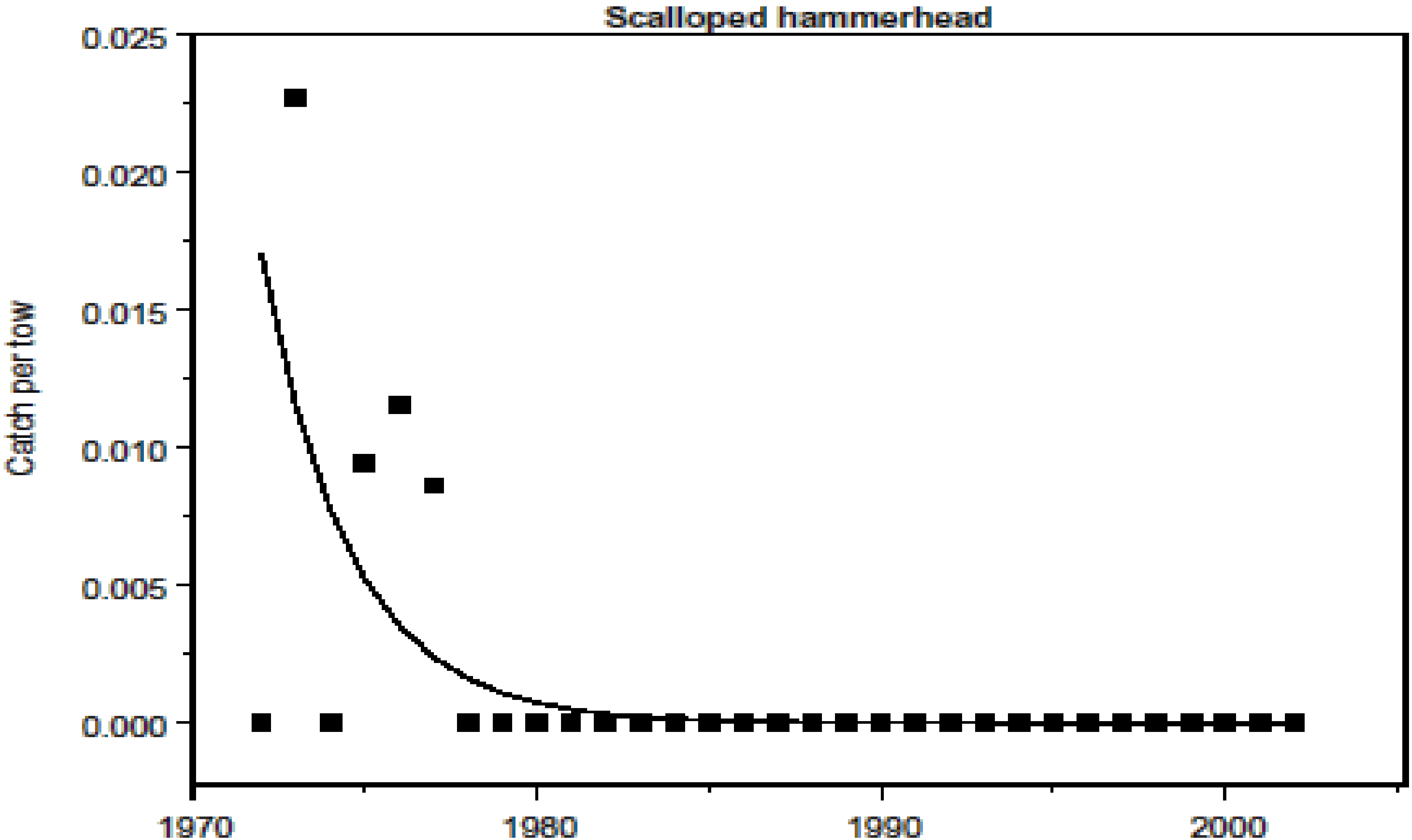
1 Caribbean
2 Gulf of Mexico
3 Florida
4 S Atlantic Bight
5 Mid Atlantic Bight
6 NE Coastal
7 NE Distant
8 Sargasso
9 S America



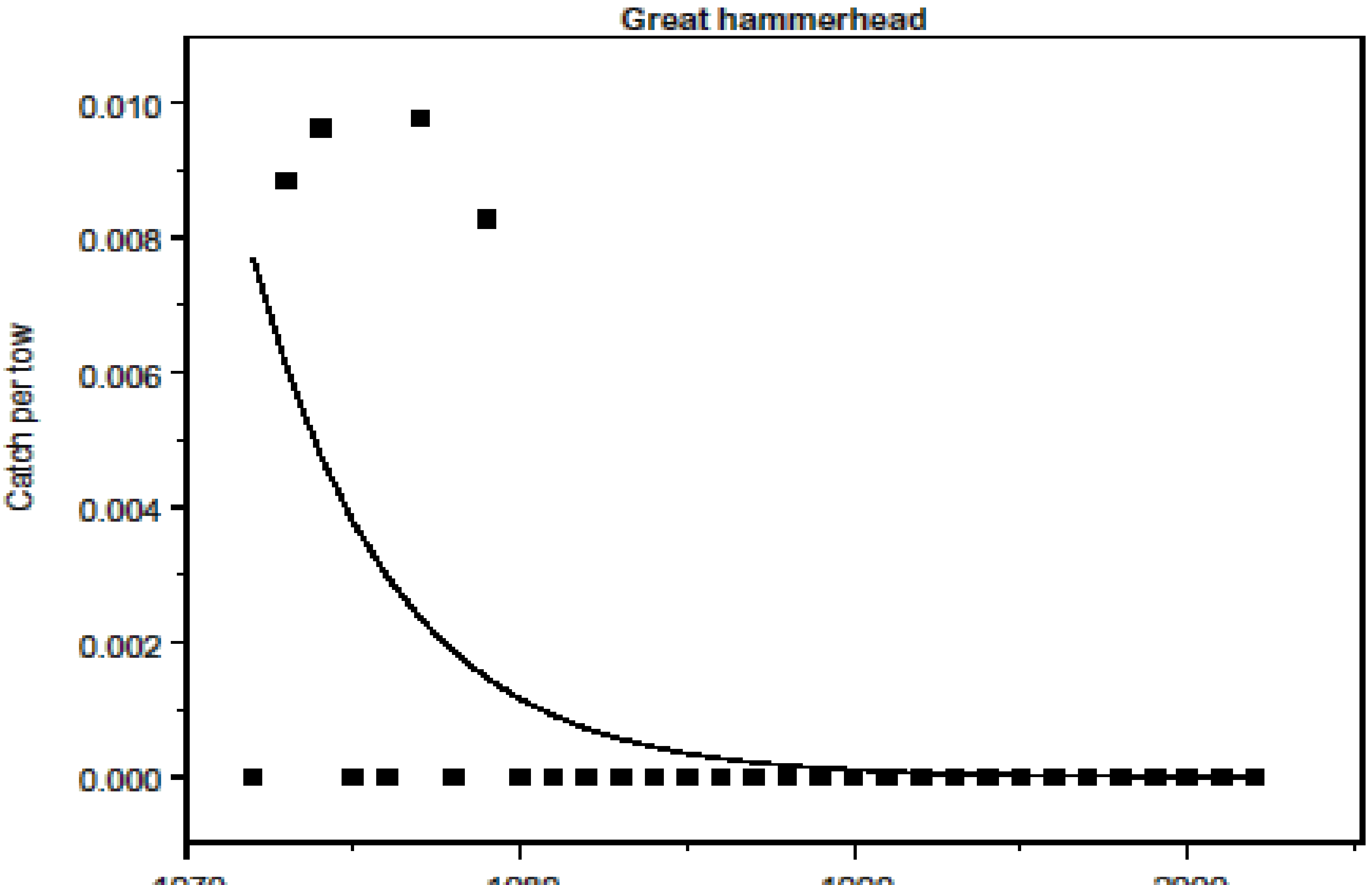


TNB
NB - all data
NB - vessels recorded species once
NB - vessels recorded species every year
DL - all data
DL - vessels recorded species once
DL - vessels recorded species every year
A Hammerhead spp.
B White
C Tiger
D Coastal spp.
E Blue
F Mako spp.
G Thresher spp.
H Oceanic whitetip
Estimated annual percent change
0
-5
-10
-15
-20
-25
1 2 3 4 5 6 7
TNB
NB
TNB
TNB
TNB

Same results for trawl surveys in Gulf of Mexico



Same results for trawl surveys in Gul of Mexico

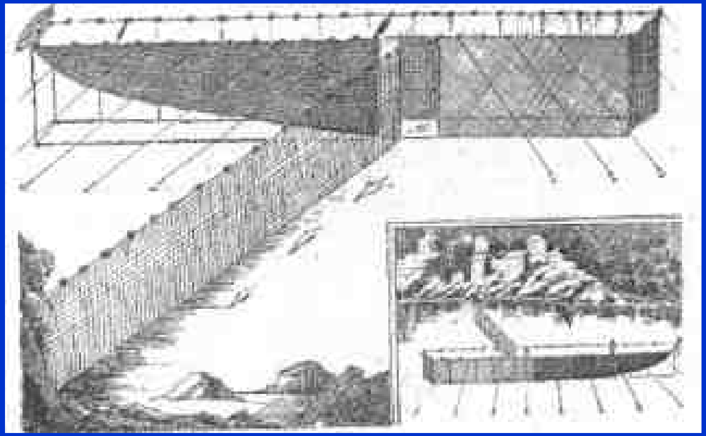


Decline of Mediterranean Sharks

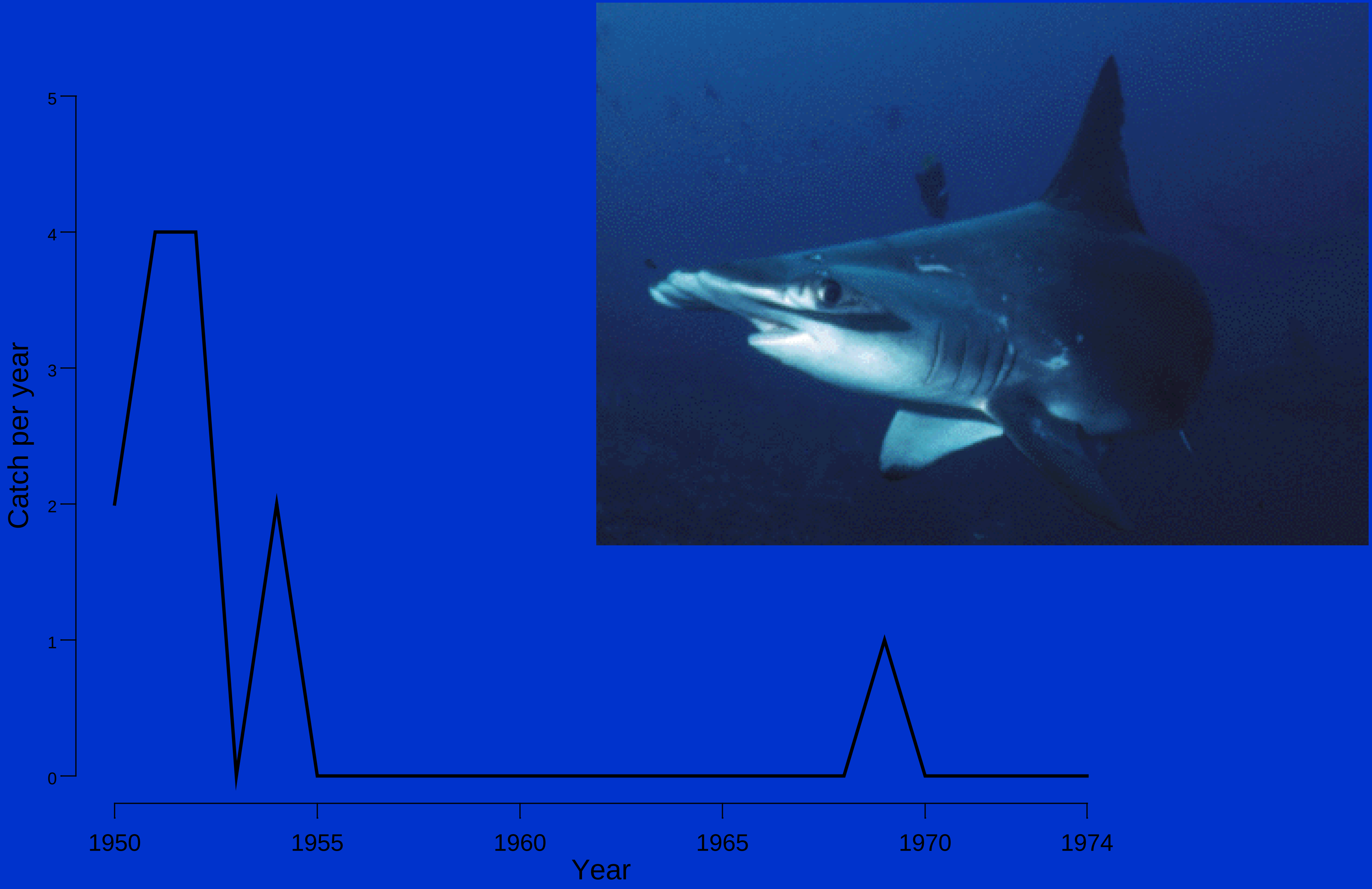
By catch associated with a Tuna Trap

In Ligurian Sea

“Tonnara di Camogli”

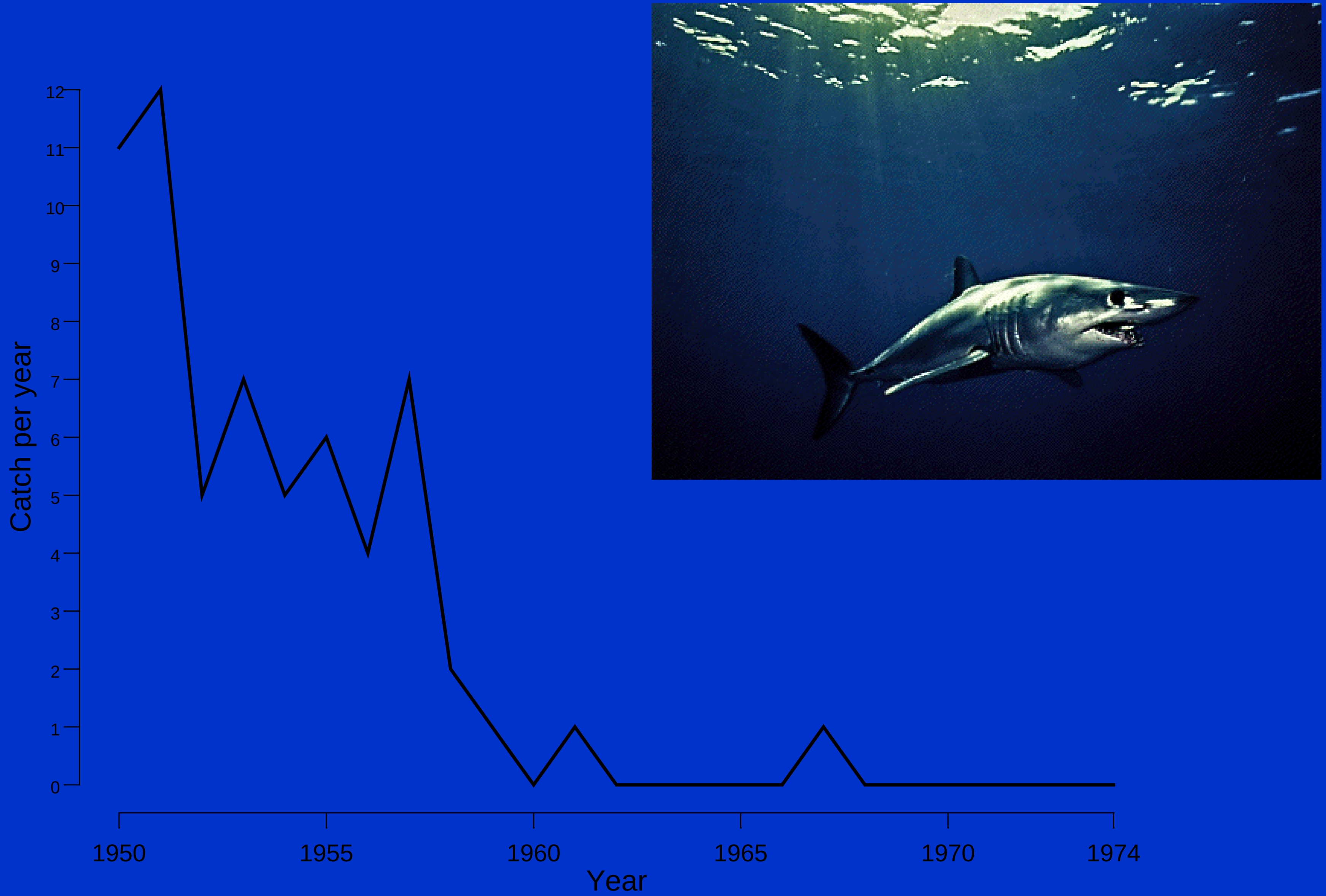


Decline of Hammarhead sharks



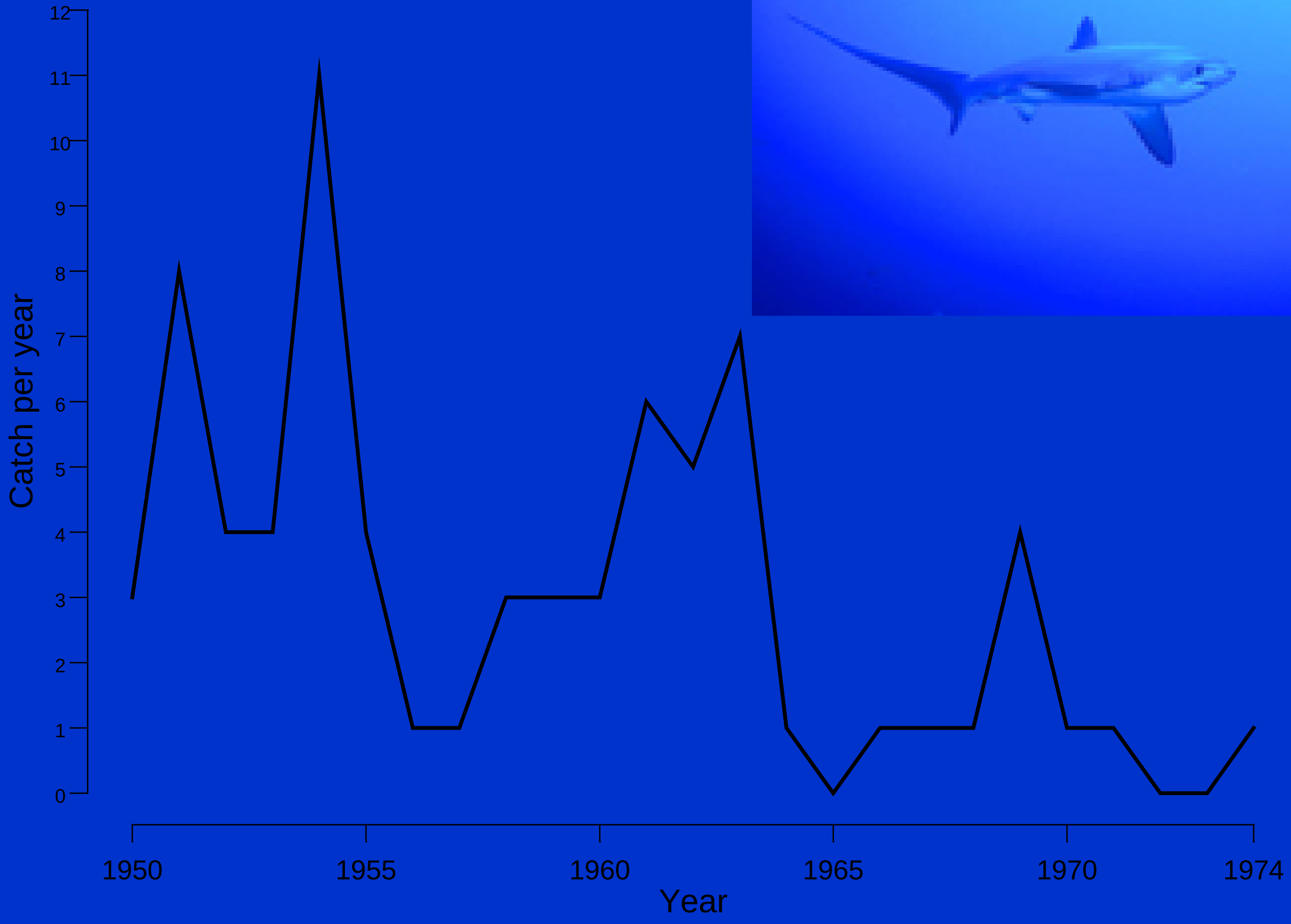
Boero F. & A. Carli 1979 – Boll. Mus. Ist. Biol. Univ. Genoa (47)

Decline of Mako sharks



Boero F. & A. Carli 1979 – Boll. Mus. Ist. Biol. Univ. Genoa (47)

Decline of Thresher sharks



Boero F. & A. Carli 1979 – Boll. Mus. Ist. Biol. Univ. Genoa (47)

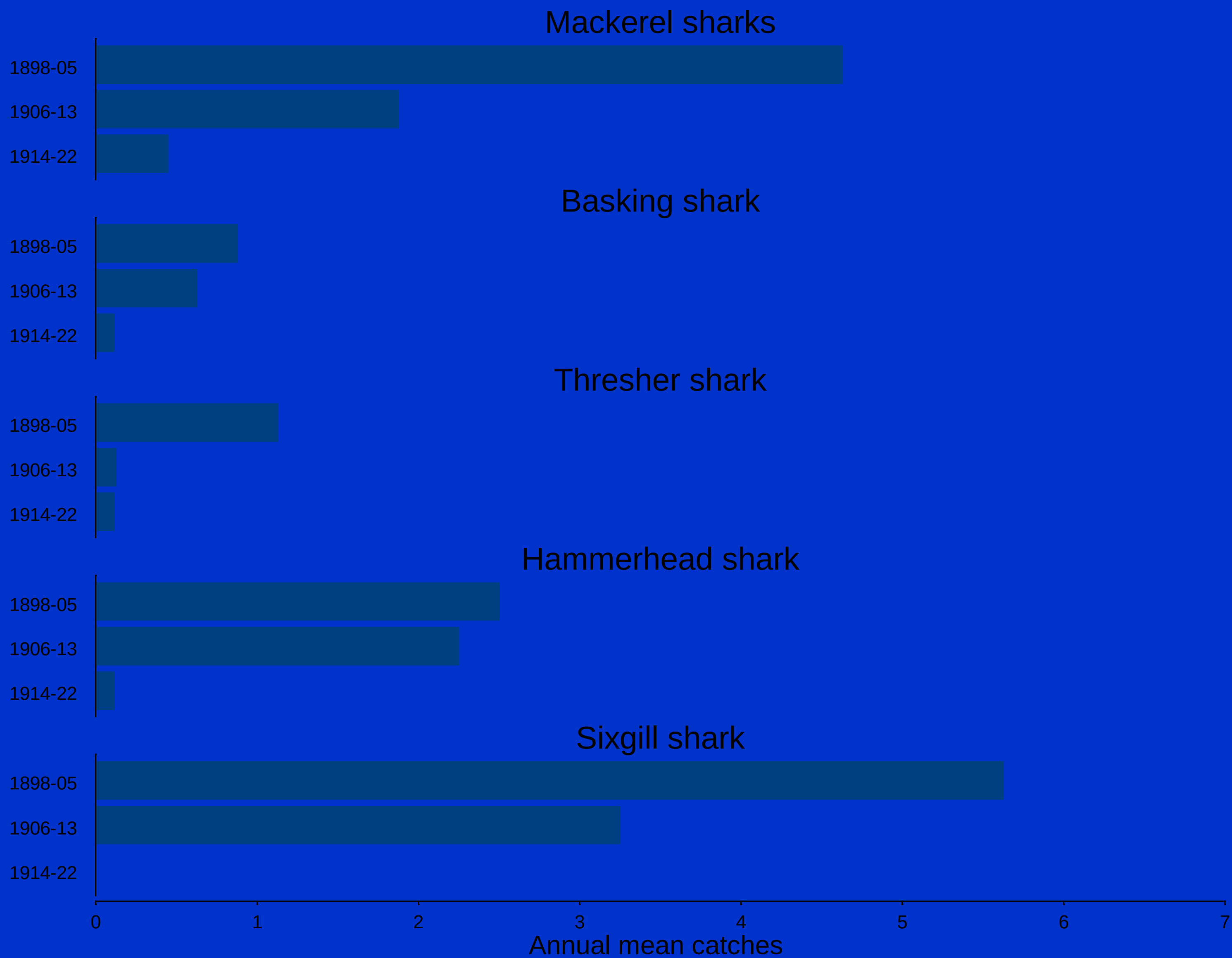
Decline of Mediterranean Sharks

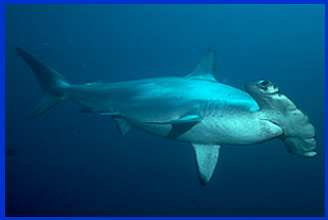
By catch associated with a Tuna Trap
In Tirrenian Sea

“Tonnarella di Baratti”

Decline in Large Sharks's Catches by an Italian Tuna Trap

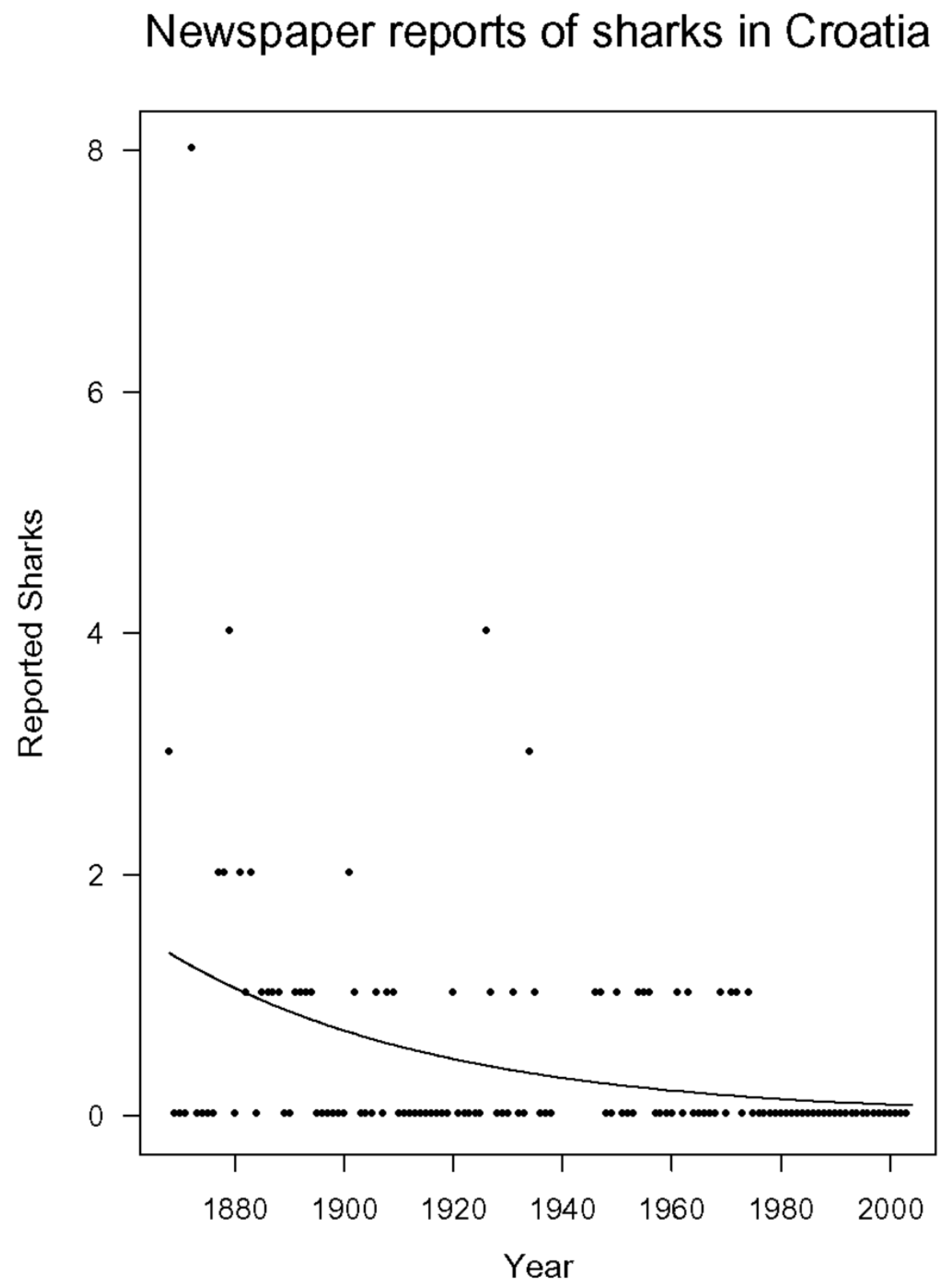
Baratti's "Tonnarella"





Vacchi M. *et al.* 2000 - 4th-Meeting-of-the-European-Elasmobranch-Association-Proceedings

Fitting a simple model to crazy data can yield reliable, and very powerful conclusions



With training, “experts” can ignore the most obvious of data:

1872 - Man's head and leg and dolphin in stomach

1872 – 8 Great White Sharks reported caught

1888 - Woman's body and lamb in stomach

1894 - Preserved at Zagreb Nat. Hist. Mus.

1926 - Woman's shoes, laundry in stomach

1946 - Pig of 10 kg in stomach

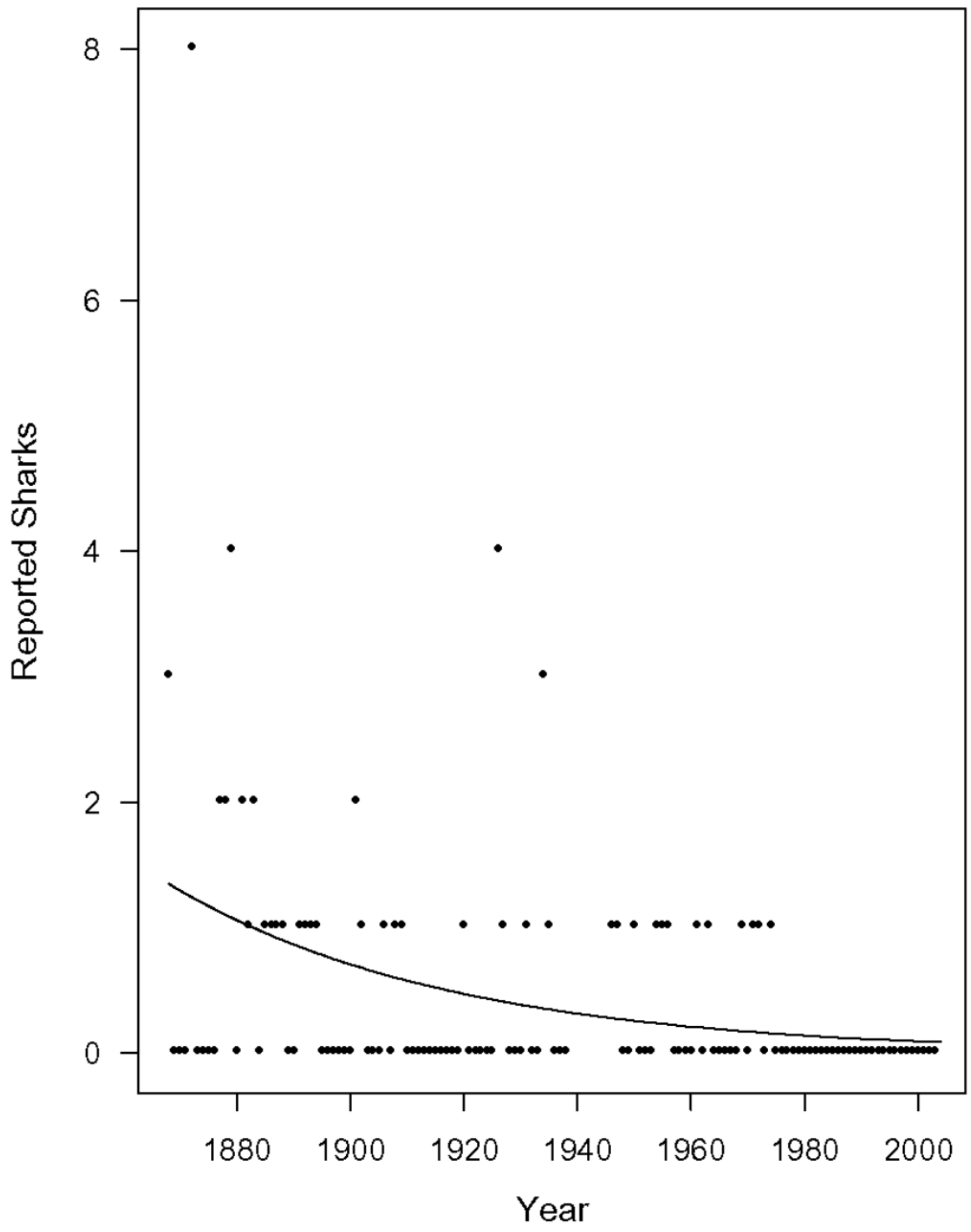
1950 - Encounter during eating a dead calf

1954 - Attack on boat

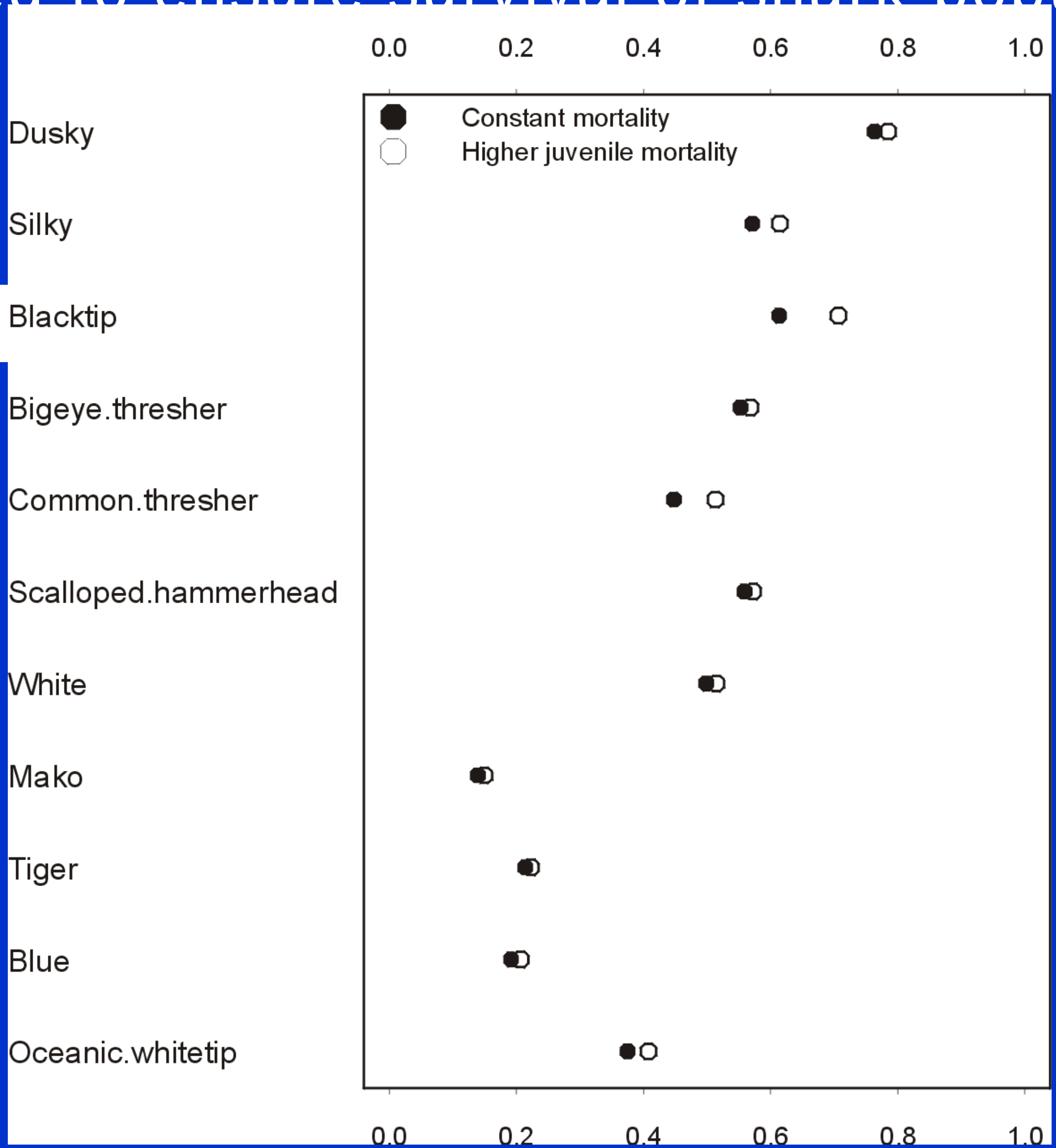
1975+ -No sightings.

Soldo and Jardas, Periodicum Bologorum, 2002

Newspaper reports of sharks in Croatia



Proportional reduction in current fishing mortality needed to ensure survival of shark populations



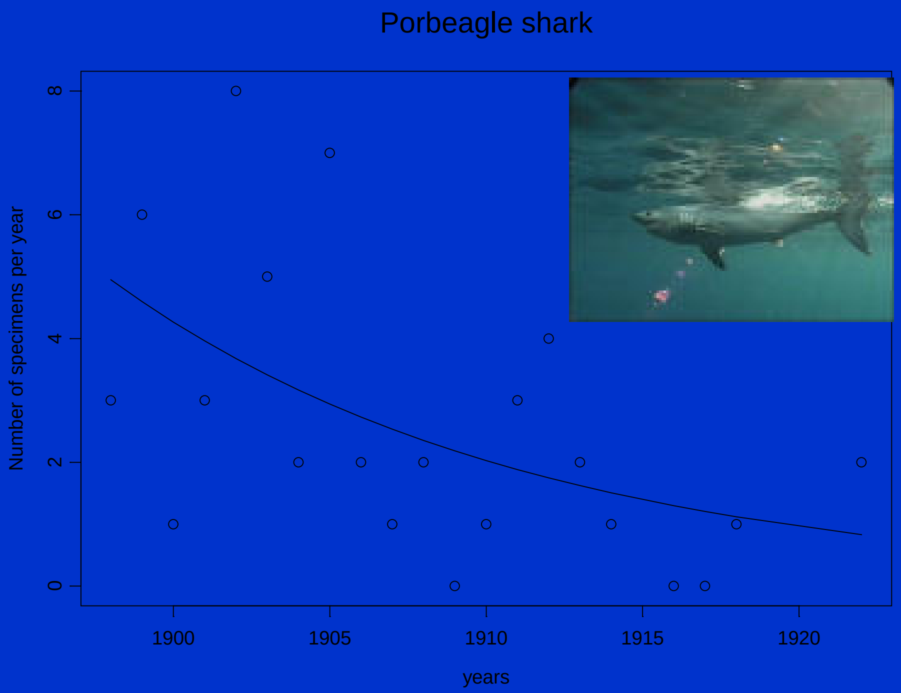
Myers & Worm, in press PRSB

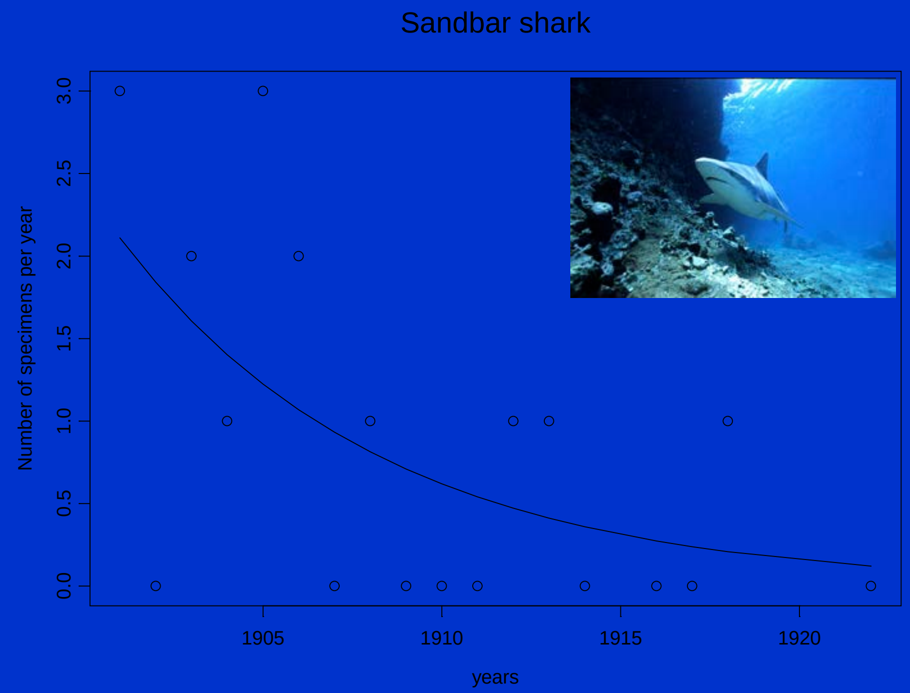
There are at least 2 scalloped hammerhead sharks in the Northwest Atlantic

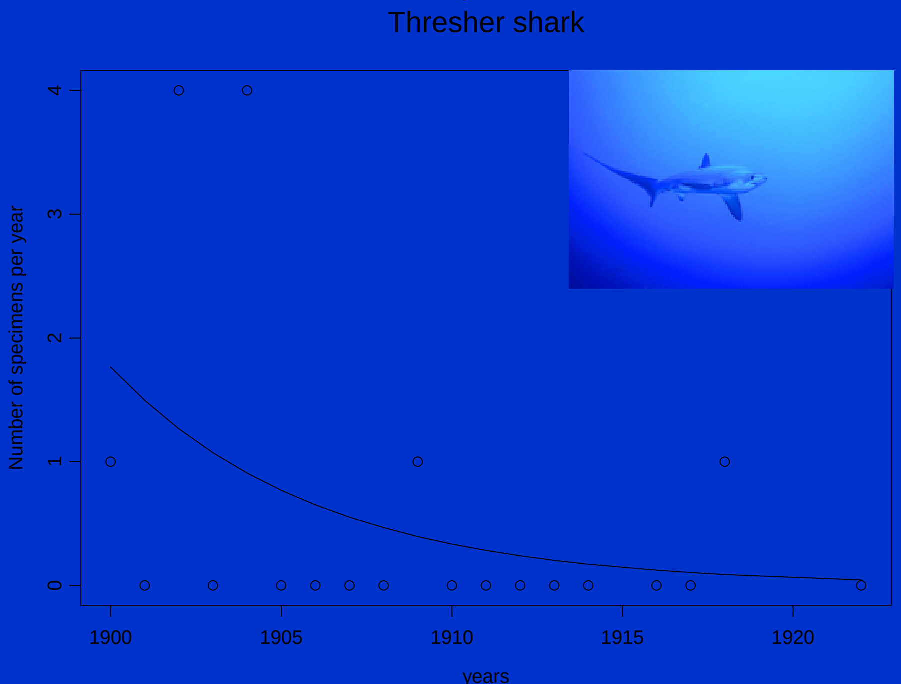
Stoner, D. S., J. M. Grady, W. B. Driggers, K. A. Priede and J. M. Quattro. Molecular Evidence for a Cryptic Species of Hammerhead Shark (Genus *Sphyrna*). *Marine Biology* (submitted).

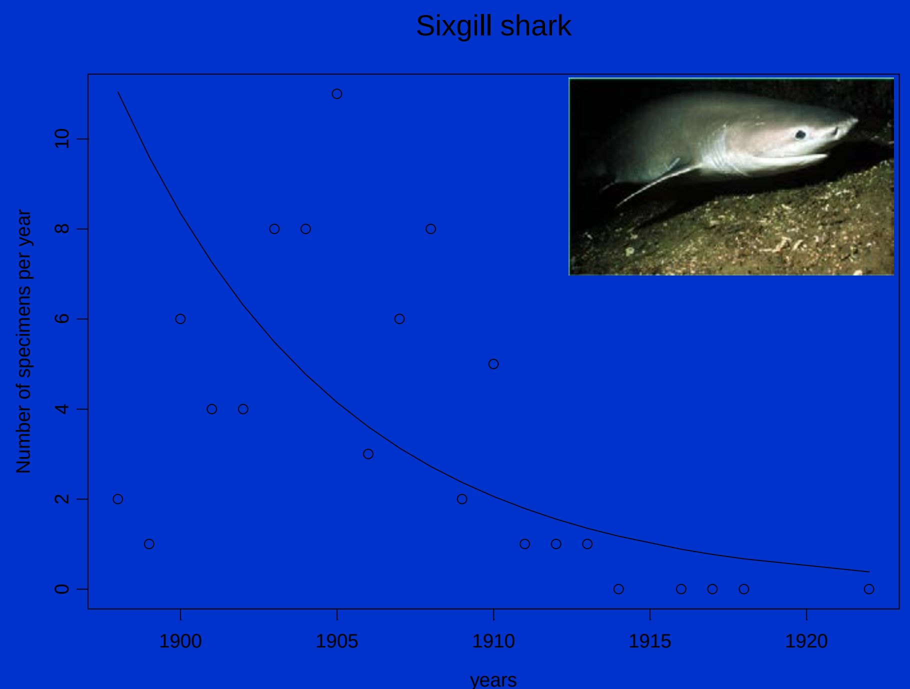
Vacchi et al (2000) in Tuscany, on the Baratti's Tuna trap

"Tonnarella di Baratti"

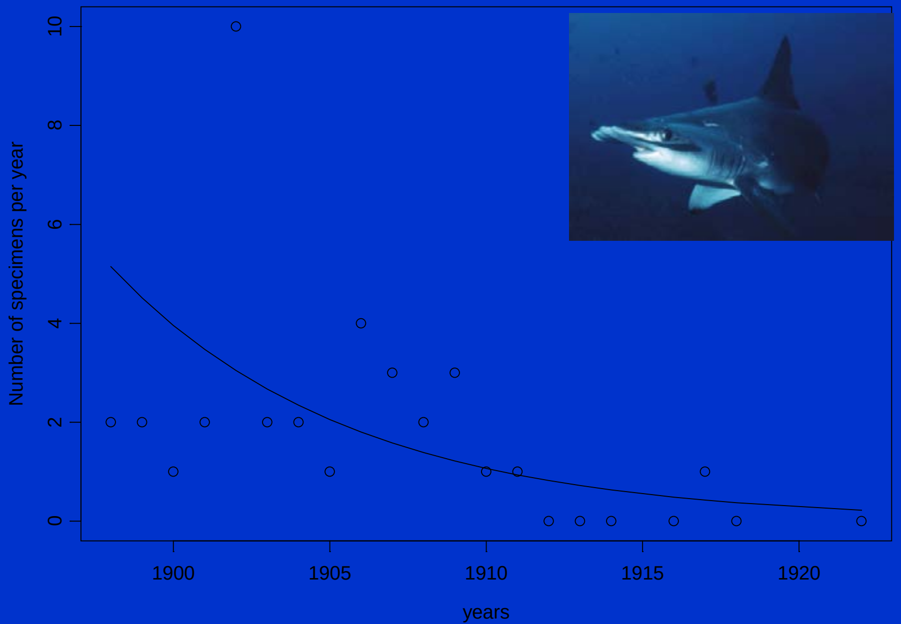

Porbeagle shark
Number of specimens per year
0
2
4
6
8
1900
1905
1910
1915
1920
years


Sandbar shark
Number of specimens per year
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1905
1910
1915
1920
years

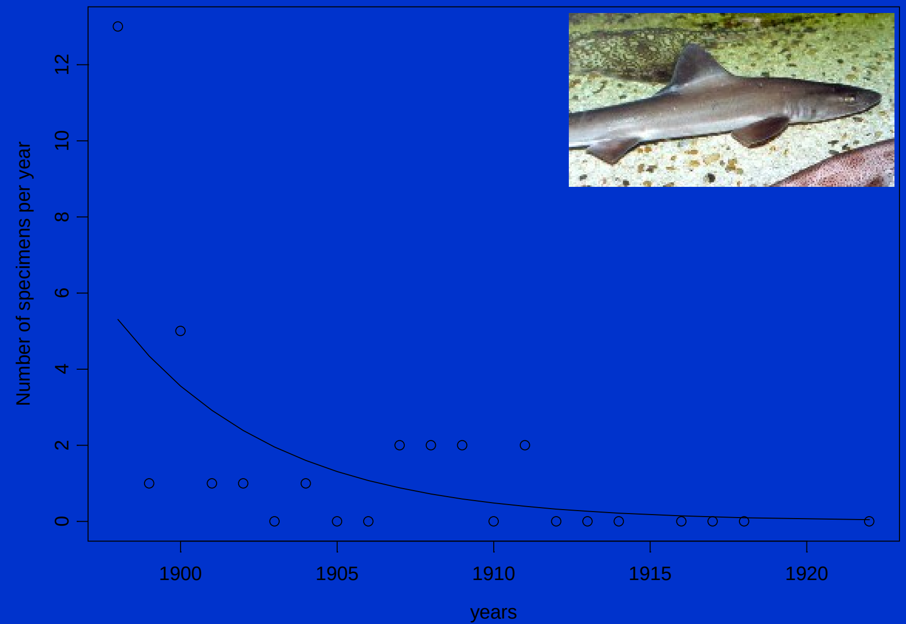

Thresher shark
Number of specimens per year
0
1
2
3
4
1900
1905
1910
1915
1920
years


Sixgill shark
Number of specimens per year
0
2
4
6
8
10
1900
1905
1910
1915
1920
years

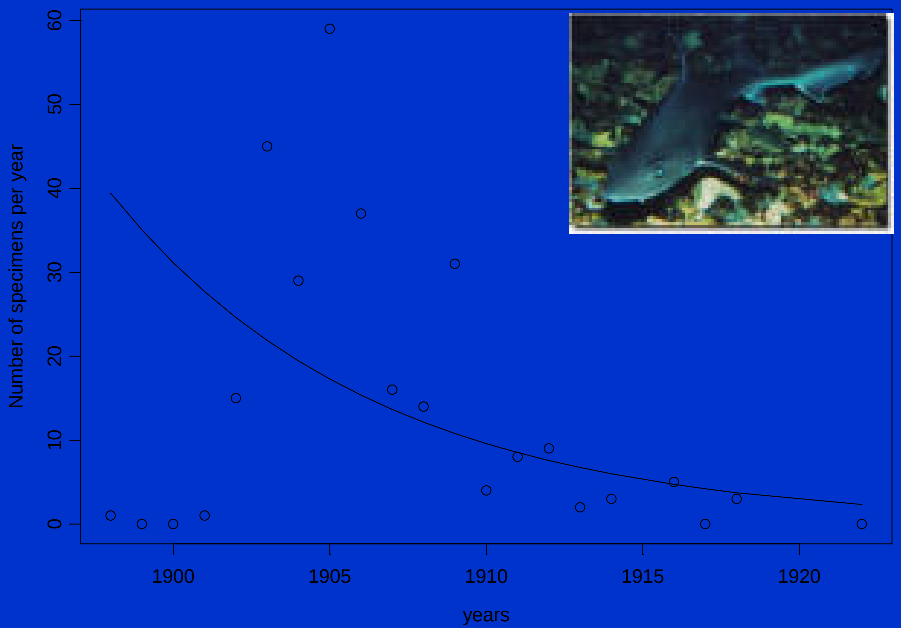
Hammerhead shark



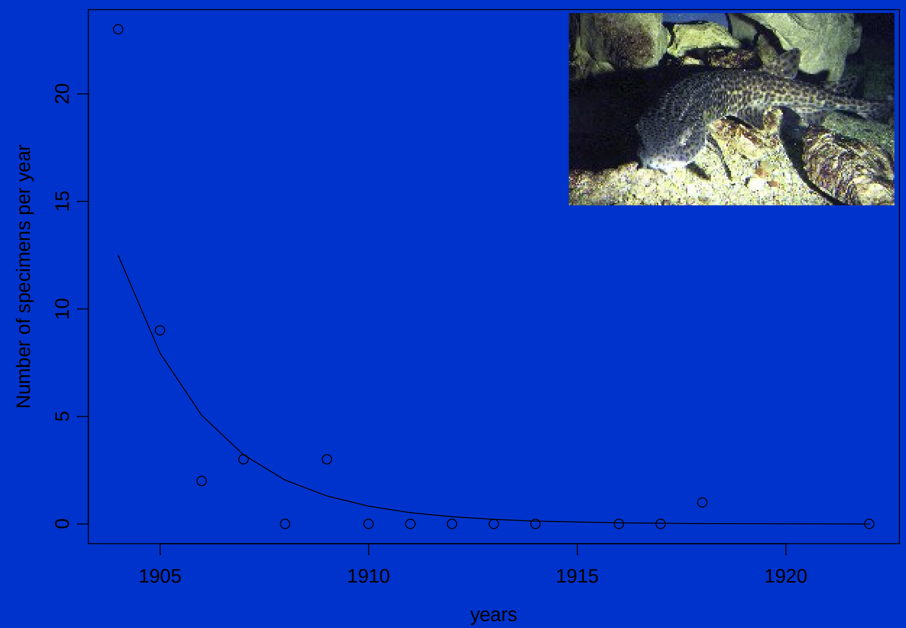
Smooth-hound

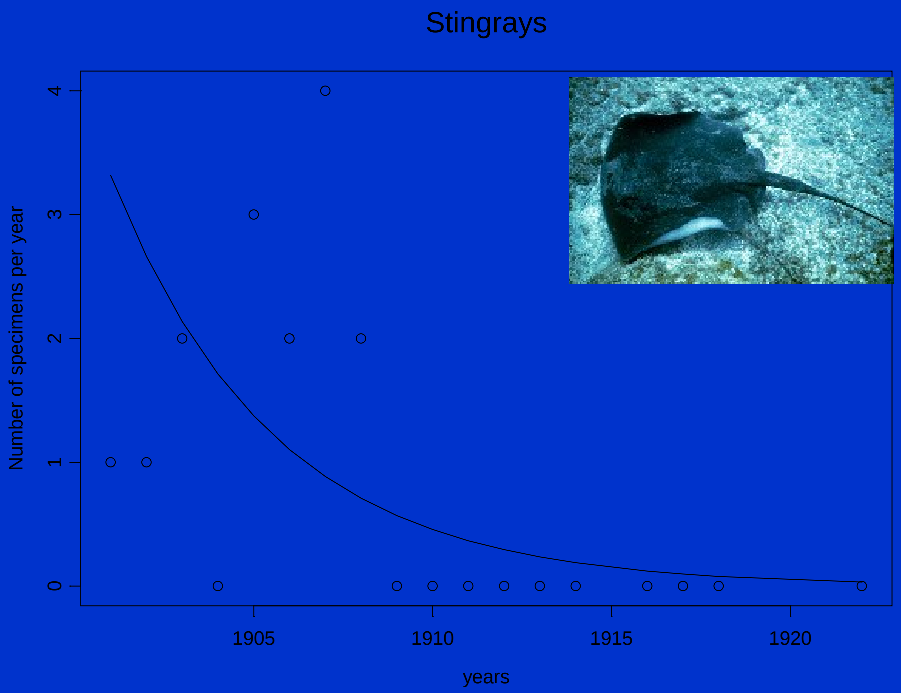


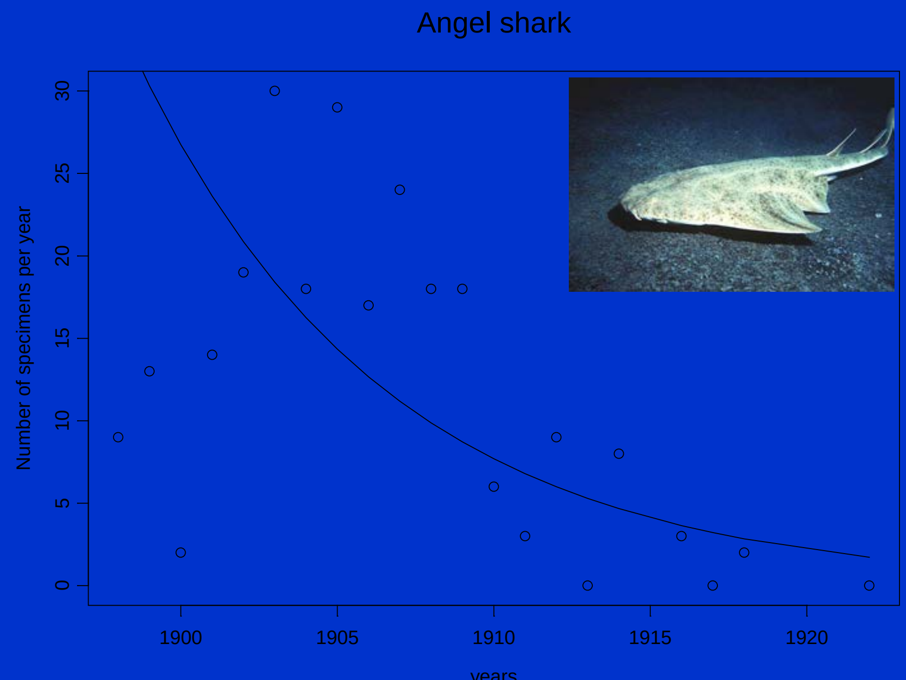
Starry smooth-hound

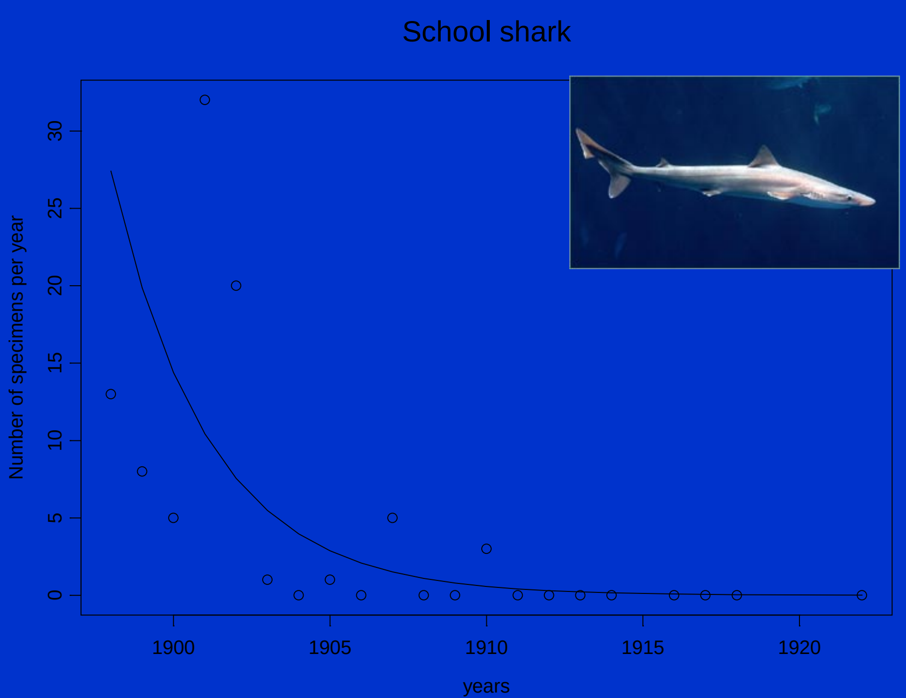


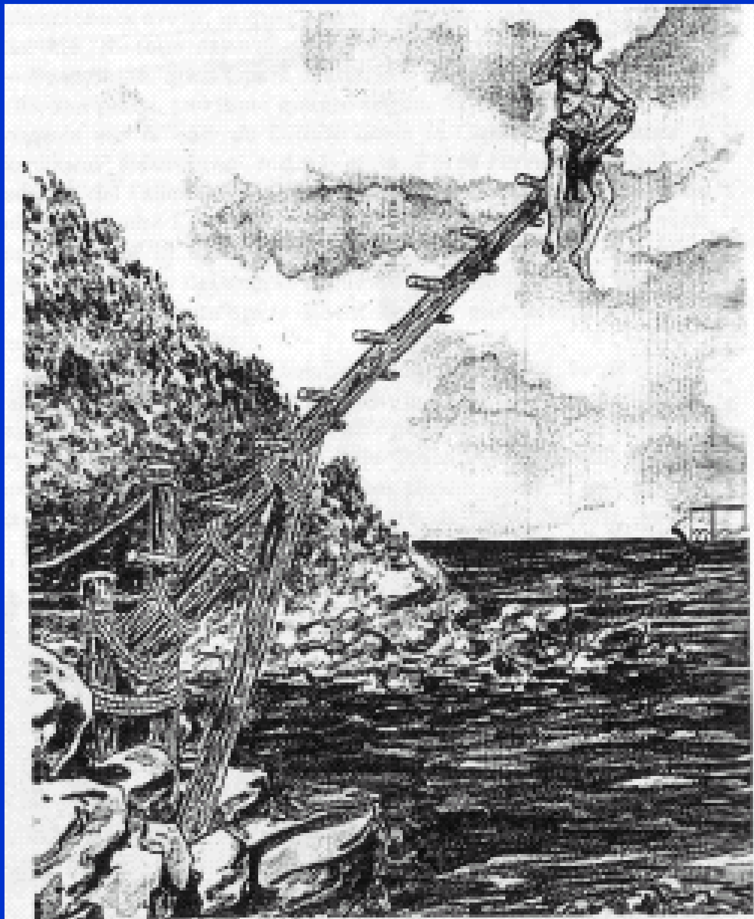
Nursehound

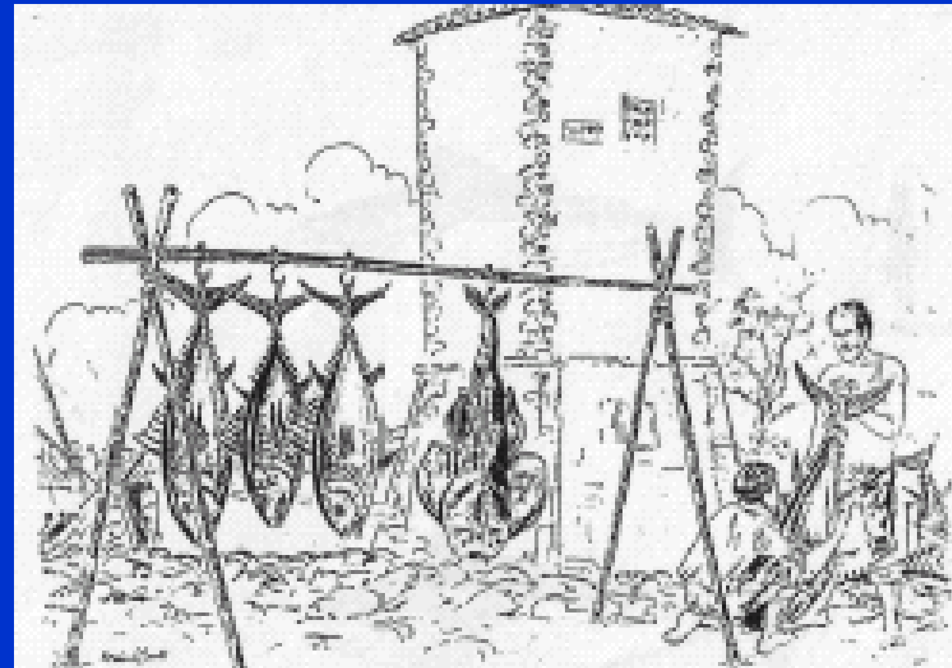



Stingrays
Number of specimens per year
0
1
2
3
4
1905
1910
1915
1920
years


Angel shark
Number of specimens per year
0
5
10
15
20
25
30
1900
1905
1910
1915
1920
years


School shark
Number of specimens per year
0
5
10
15
20
25
30
1900
1905
1910
1915
1920
years





Outline

- Background on the lab and the two projects
- Sources of data
- Modelling framework

- Data from a user's perspective
- Data from a provider's perspective

- RONs and beyond OBIS schema v1.0

Myers lab at Dalhousie

- Dr. Ransom Myers, principal researcher
- Numerous academic collaborators, both at Dal and elsewhere
- 1 lab administrator
- 1 computer administrator
- 1 statistical consultant
- 2 research assistants
- 15 graduate students
- 5 post-docs

http://fish.dal.ca

Future of Marine Animal Populations

- Prediction arm of CoML
- Components
  - – Statistical design for CoML
  - – Data exchange and model interface
  - – Model development and sharing
  - – Data synthesis
  - – Predictions (Future of Marine Life)

http://www.fmap.ca

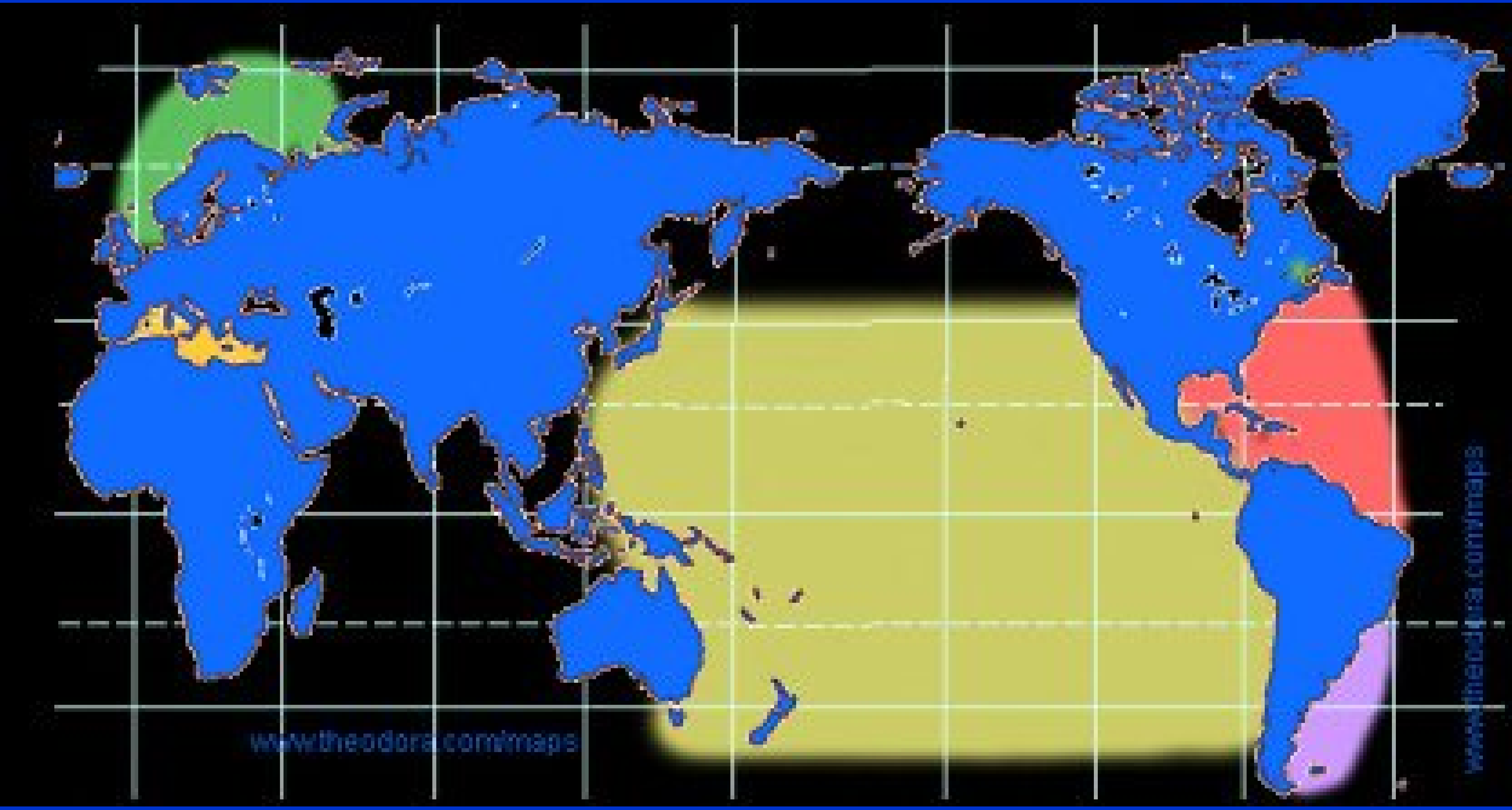
Pew Global Shark Assessment

- Effort to establish an information baseline for elasmobranch populations (sharks, skates and rays)

- Key deliverables
  - Estimates of the distribution and absolute abundance of the world's major elasmobranch species over the last century

http://www.globalsharks.ca

GSA coverage as of Dec. 2004



Data sources

- Usual suspects
  - FAO and regional bodies such as NAFO, ICES, …
- Atlantic
  - NW: US longline fishery (targeting swordfish mostly), trawl surveys
  - NE: EU surveys
  - S: Argentinean surveys
- Pacific
  - S: US longline survey
- Mediterranean
  - EU groundfish surveys (historical data back to 1950)
  - Tuna traps (tonnara)
  - Interviews with fishers
- World
  - Interviews with historical recreational diver interviews for reef sharks, linked to research dive surveys
  - Research observations over the last 30 years from jellyfish surveys (Larry Madin, WHOI).

Not all data are of the same quality

- Commercial landings

Often does not have effort, i.e. can't infer catch rate

- Commercial catch and effort

Catch rate can be calculated BUT

- Effort is not random
- Bycatch is not always recorded
- High grading and other practices

DEVELOP OF ROBUST METHODS ESSENTIAL

- Observers data on commercial fleet

Taxonomically correct (to a point), unbiased recording, bycatch included

- Scientific surveys

Follows a sampling strategy, statistical design, stratification scheme

  – Recreational diver logbooks

Can be surprisingly interesting and useable

- Opportunistic data

Getting reliable data – Transactions with agencies/institutions

- Data request → TOR → data released
- For user, updating the data requires a new transaction
- The data transaction puts burden on the provider
- User is often restricted in redistributing the data

Data from institutions and agencies
Raw vs. processed

- Data obtained from institutions/agencies is never the raw data collected (too voluminous, not easily interpretable)

- What level of detail does the user want?
  - Spatial aggregation
  - Temporal aggregation
  - Taxonomic detail
  - Abundance vs. biomass
  - Life stages
  - Condition, growth
  - NULL vs. zero
  - …
- Recent data requests from our lab include transactions with NMFS, DFO, ICES, …

Observers data from DFO – occurrence of sponges and elasmobranch species

```
CREATE OR REPLACE VIEW RICARD
AS
select sets.*, catch.specscd_id, catch.specscd_wgt, catch.sponge, catch.barndoorskate, catch.thornyskate, catch.smoothskate, catch.littleskate,
                              catch.winterskate, catch.skateunidentified, catch.greenlandshark, catch.baskingshark, catch.total_kg
from
(select to_number(t.trip_id||'.'||f.fishset_id) setid, ctrycd_id, to_char(setdate,'YYYYMMDD') setdate, tripcd_id,
       t.OBSCD_ID, gearcd_id, v.grt, f.nafarea_id, latitude lat, longitude lon,
       botcd_id, depth,
                              est_catch est_total_catch
  from observer.isvessels v,observer.istrips t,observer.isgears g,
       observer.isfishsets f,observer.issetprofile p
  where
  p.latitude is not null and
  p.longitude is not null and
  v.vess_id=t.vess_id and
  t.trip_id=g.trip_id and
  g.gear_id=f.gear_id and
  f.fishset_id=p.fishset_id and
  tripcd_id <=7002 and
  p.pntcd_id=
    DECODE(g.gearcd_id,1,2,2,2,3,2,4,2,6,2,7,2,8,2,9,2,10,2,11,2,
          12,2,13,2,14,2,15,2,16,2,17,2,19,2,20,2,21,2,22,2,23,2,
          24,2,30,2,31,2,39,1,40,1,41,1,42,1,49,1,50,1,51,1,52,1,
          53,1,54,1,55,2,58,1,60,1,61,1,62,1,63,1,71,2,72,2,81,1,0)
group by to_number(t.trip_id||'.'||f.fishset_id), ctrycd_id, setdate, tripcd_id,  t.OBSCD_ID,
       gearcd_id, v.grt, f.nafarea_id, latitude, longitude,
       botcd_id, depth,
                              est_catch) sets,
(select to_number(t.trip_id||'.'||f.fishset_id) setid, specscd_id,
       SUM(DECODE(speccd_id,specscd_id,est_combined_wt,NULL)) specscd_wgt,
       SUM(DECODE(speccd_id,8600,est_combined_wt,NULL)) sponge,
       SUM(DECODE(speccd_id,200,est_combined_wt,NULL)) barndoorskate,
       SUM(DECODE(speccd_id,201,est_combined_wt,NULL)) thornyskate,
       SUM(DECODE(speccd_id,202,est_combined_wt,NULL)) smoothskate,
       SUM(DECODE(speccd_id,203,est_combined_wt,NULL)) littleskate,
       SUM(DECODE(speccd_id,204,est_combined_wt,NULL)) winterskate,
       SUM(DECODE(speccd_id,211,est_combined_wt,NULL)) skateunidentified,
       SUM(DECODE(speccd_id,237,est_combined_wt,NULL)) greenlandshark,
       SUM(DECODE(speccd_id,233,est_combined_wt,NULL)) baskingshark,
                              SUM(est_combined_wt) total_kg
  from observer.istrips t, observer.isfishsets f, observer.iscatches c
  where
  t.trip_id=f.trip_id and
  f.fishset_id=c.fishset_id and
--  speccd_id in (8600,8621,200,201,202,203,204,211,237,233) and
  tripcd_id <=7002
group by to_number(t.trip_id||'.'||f.fishset_id), specscd_id) catch
where sets.setid=catch.setid(+)
```

- Select all relevant fishing sets
  - Recode detailed gear codes into gear classes
- Select all relevant species catches
  - Arrange species as columns
- Combine fishing sets and catches
  - NULLs are used for negative observations to reflect sampling protocol

Data for RAM and Susanna Fuller

SQL view courtesy of Bob Branton, DFO

Could we get these data through OBIS?

Modelling framework

- Meta-analytical methods to combine evidence across studies: different populations as replicates of a natural experiment
- Recent publications have required “Supplementary Materials”

Modelling framework (cont.)

- Replicability of model results is essential
- Updating model results when new data becomes available, improving models in light of new information

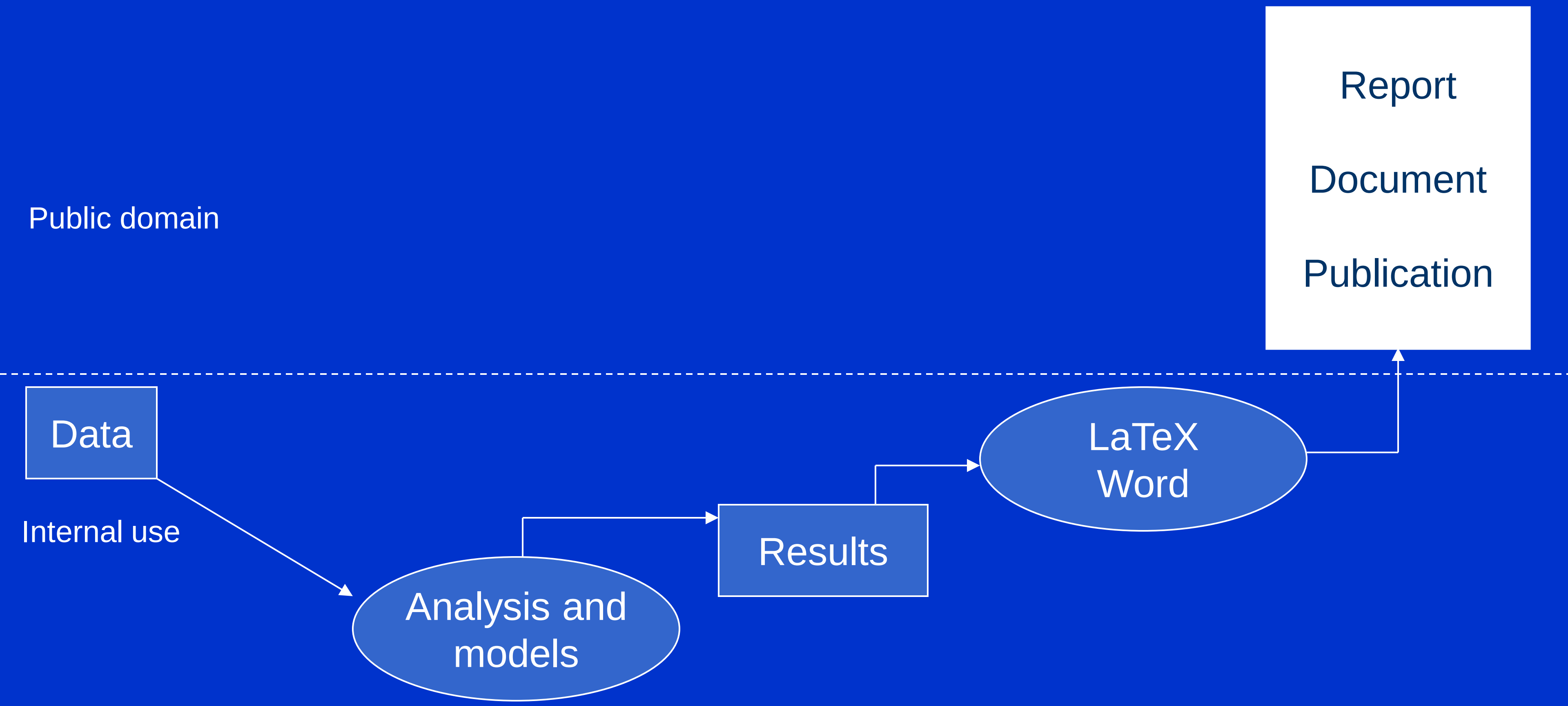
- Set of input/output, visualisation and analytical tools can be developed when the data used follow a standard

Scientific debate when data, models and results are publicly available

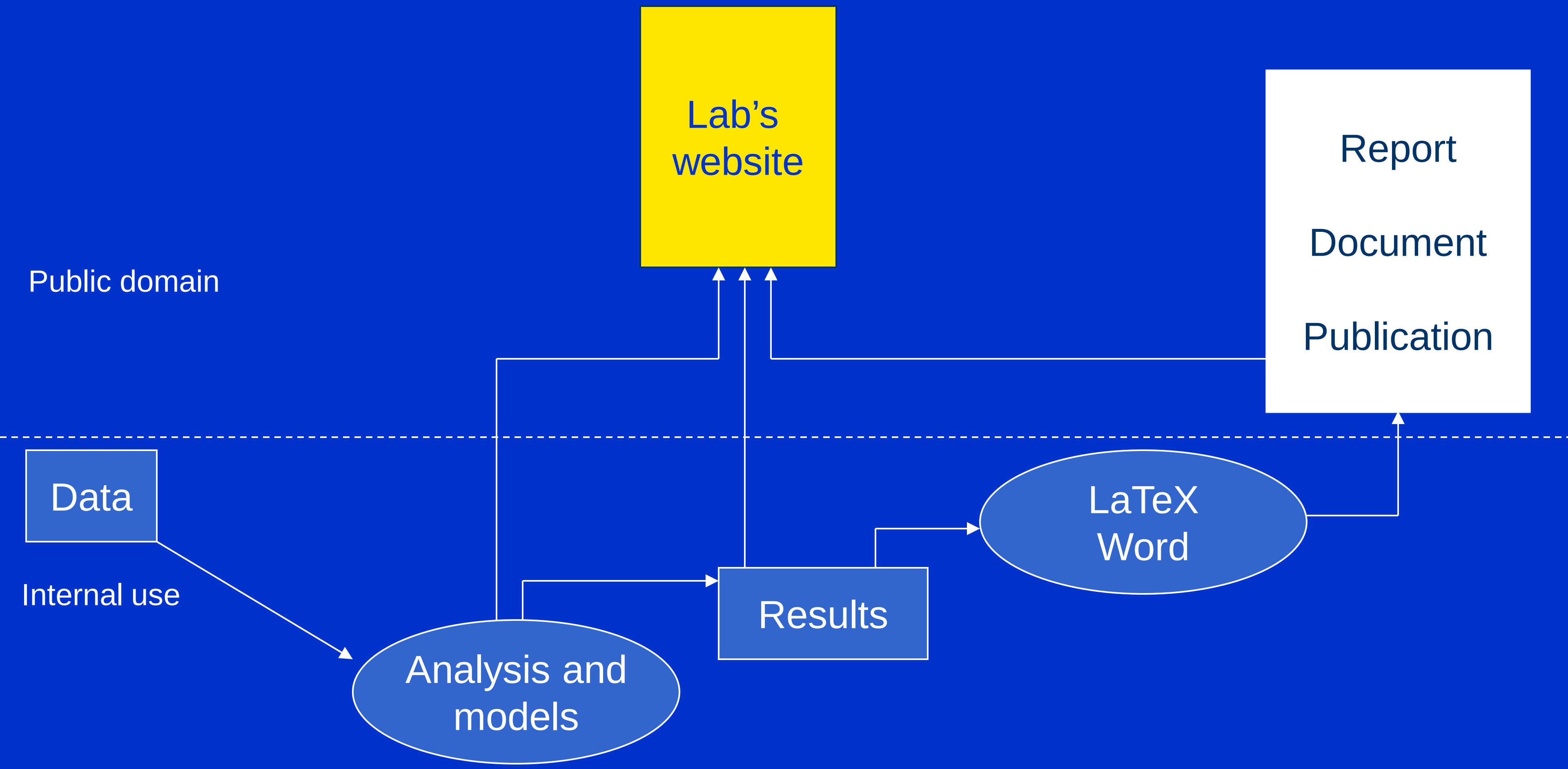
- A healthy scientific discourse requires exchanges, criticisms, objections, alternatives, …

- Transparency in research leads to more constructive situations
  - If someone says “I would do it this way”, they can, the data used are available to them
  - If someone says “How was this really done?”, they can access the model details and the results

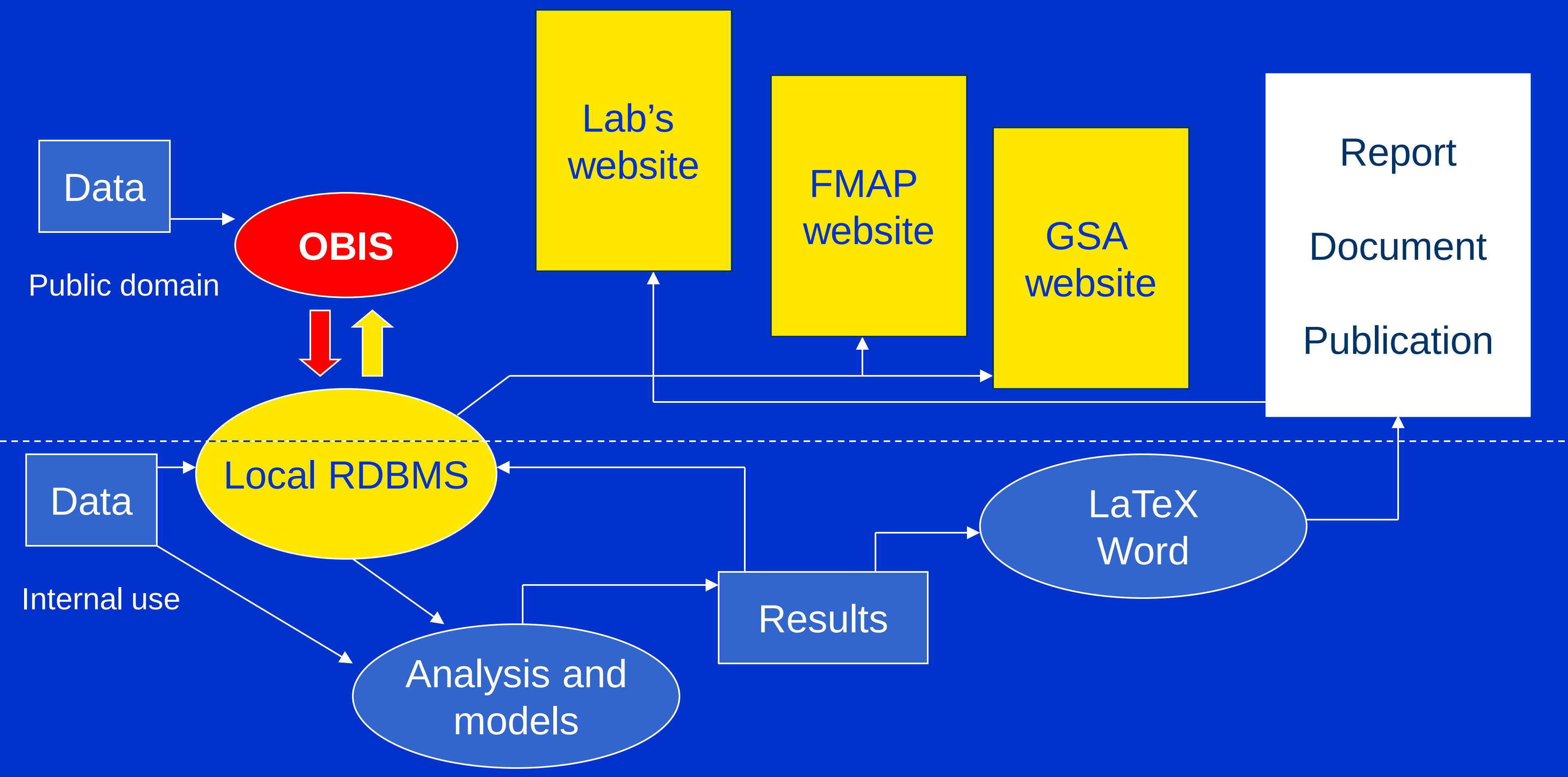
Traditional dissemination



Ad hoc digital dissemination



Distributed dissemination



Limitations of the OBIS schema

- Populations and communities, not just species, are ecologically significant, yet the concepts are not easily implemented under current schema
- We're interested in spatial and temporal variability, current OBIS schema does not easily support this

RONs and the next OBIS schema

- Opportunity to collaborate with regional institutions (DFO, CMB)
- Opportunity to experiment with new tools and standards
- Opportunity to improve the OBIS schema

Conclusion

- OBIS will facilitate data transactions between users and agencies/institutions
- For our own system (Dalhousie), information system using RDBMS to ease the integration to OBIS
- RONs and next OBIS will expand our capabilities of conducting ecological research at a global scale

Lab’s web page http://fish.dal.ca

FMAP http://www.fmap.ca

Global Sharks Assessment http://www.globalsharks.ca