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HOKKAIDO UNIVERSITY

Practical approaches for research and assessment in data-poor/limited situation with fisheries communities

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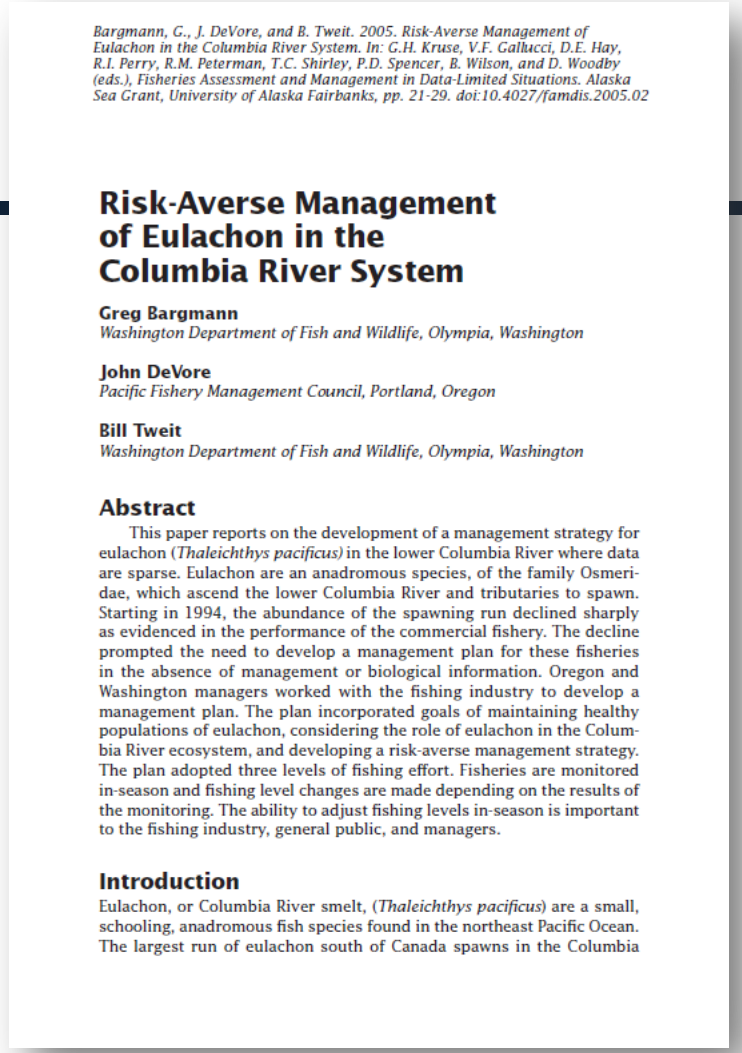
Maturity: Lm 15.5, range 15 - 16 cm
Max length : 34.0 cm TL
Max. reported age: 5 years

https://www.fisheries.noaa.gov/species/eulachon

Eulachon (*Thaleichthys pacificus*) and management in the Columbia River System

Hailey Eckstrand, 2017

- Satellite place
- Commercial landing information (only catch) by ticketed fishermen
- Fishing has began since prehistoric time, but active management was began from 1995



Bargmann, G., J. DeVore, and B. Tweit. 2005. Risk-Averse Management of Eulachon in the Columbia River System. In: G.H. Kruse, V.F. Gallucci, D.E. Hay, R.I. Perry, R.M. Peterman, T.C. Shirley, P.D. Spencer, B. Wilson, and D. Woodby (eds.), Fisheries Assessment and Management in Data-Limited Situations. Alaska Sea Grant, University of Alaska Fairbanks, pp. 21-29. doi:10.4027/famdis.2005.02

Risk-Averse Management of Eulachon in the Columbia River System

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Abstract

This paper reports on the development of a management strategy for eulachon (*Thaleichthys pacificus)* in the lower Columbia River where data are sparse. Eulachon are an anadromous species, of the family Osmeridae, which ascend the lower Columbia River and tributaries to spawn. Starting in 1994, the abundance of the spawning run declined sharply as evidenced in the performance of the commercial fishery. The decline prompted the need to develop a management plan for these fisheries in the absence of management or biological information. Oregon and Washington managers worked with the fishing industry to develop a management plan. The plan incorporated goals of maintaining healthy populations of eulachon, considering the role of eulachon in the Columbia River ecosystem, and developing a risk-averse management strategy. The plan adopted three levels of fishing effort. Fisheries are monitored in-season and fishing level changes are made depending on the results of the monitoring. The ability to adjust fishing levels in-season is important to the fishing industry, general public, and managers.

Introduction

Eulachon, or Columbia River smelt, (*Thaleichthys pacificus*) are a small, schooling, anadromous fish species found in the northeast Pacific Ocean. The largest run of eulachon south of Canada spawns in the Columbia

Memories with Eulachon and Columbia River

- Since end of 1990s', working in the Columbia River
- Eulachon distribute over Alaska also…Livinng with it 5 years

~~ADVENTURE~~

EXPEDITION

Data poor situation in reality

- No sufficient data and information amount or quality for present analyses and assessment

Because of :

- History of monitoring
- Satellite location
- Not sufficient design for present alternatives of assessment
  - Ecosystem Based Management

…

Think about the approach

- With a precondition to improve data quality with adequate designs and techniques…
- **3 probable alternatives** and their combinations of “applications”:

1. Apply particular analysis methodology using a variety of data and information
2. Apply low-cost and low efforts method to collect data and information
3. Flexibly apply available information as indices

The eulachon case:
(Bargmann et al. 2005)

Table 2. Description of the three fishing levels for eulachon in the Columbia River.

Level 1—Level 1 fisheries are utilized when there is great uncertainty in run strength or indication of a poor return. Level 1 fisheries are the most conservative and scheduled to produce an annual harvest rate of 10% or less. The purpose of Level 1 fisheries is to gain insight on the spawning runs while minimizing the risk of overexploitation. Typical Level 1 fisheries might consist of one 12-24 hour fishing period in the mainstem Columbia River and one additional day in the Cowlitz River per week. Recreational fisheries would be limited to one 2-24 hour period per week in the Cowlitz River. Days and hours to be fished would be developed in conjunction with fishery participants.

Level 2—When fishery data indicate a promising abundance in the spawning run and other indices are favorable, fishing time would be increased to collect additional data. The trigger to move from a Level 1 to a Level 2 fishery is not specified, but should be carefully deliberated. Typical fishing opportunities for both recreational and commercial fisheries would be two or three days of fishing per week. The harvest rates expected under a Level 2 fishery are not quantified.

Level 3—Level 3 fisheries are the most liberal fishing seasons. Level 3 fisheries are adopted when there are indicators of strong stock abundance and productivity. Typical Level 3 commercial fisheries would be open four days per week and recreational fisheries four to seven days per week. In Level 3 fisheries the daily bag limit for recreational may be increased as well. The harvest rates expected under a Level 3 fishery are not quantified.

PRECAUTIOUS ACTION

Three Levels of fishing intensities based on indicators =

Knowledge of Industry
Speculated abundance from the run
Uncertainty

1. **Analysis of fishing data**
2. **Ancillary information collection (e.g. larval density)**

Fishing levels are **adjusted** during day and season

“FLEXIBILITY”

- Precautious approach of management from assessment with flexible application of industrial information as the index
- Dynamics of ecology was taken into account

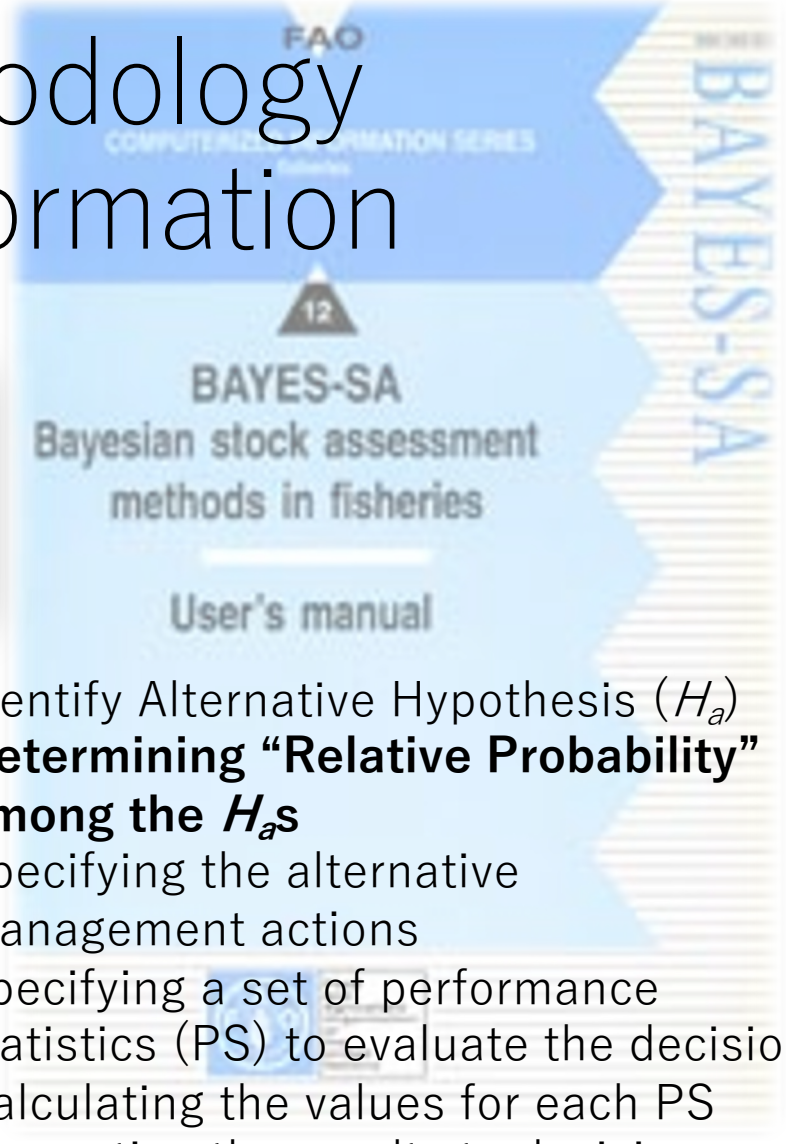
Apply particular analysis methodology using a variety of data and information

- **Bayesian approach**
  - It is nature of fisheries science that researchers have data and information-poor situation
  - Researchers introduced application of Bayesian approach for **fisheries assessment** and associated analyses
    - Punt and Hilborn (1976, 1997, 2001) Bergh and Butterworth (1987)

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Apply here !

1. Identify Alternative Hypothesis (H_a)
2. **Determining "Relative Probability" among the H_as**
3. Specifying the alternative management actions
4. Specifying a set of performance statistics (PS) to evaluate the decision
5. Calculating the values for each PS
6. Presenting the results to decision makers



Punt and Hilborn (1997)

It is **not easy to CALCULATE** without data and information!

- Punt and Hilborn (2001) suggested application of indirect information as prior information
  - Imagine you apply fisheries trustable fishermen's remarks and stock information of A area most likely applicable to assessment in B area, next to A area, with very similar conditions
- Then define the likelihood function for available direct information
  - Assuming the catch of area B is available…for example, repeat calculations with a model to estimate something else, find likelihood the catch turns to the value of the catch in B

LIKELIHOOD Prior

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Posterior Marginal

Method of maximum likelihood estimation (MLE)

- FIND frequency distribution when it derive the largest probability

HOW?

$L(\theta) = f_D(x_1, \ldots, x_n \mid \theta)$

Maximize θ

$$\frac{\partial}{\partial \theta} \log L(\theta) = 0$$

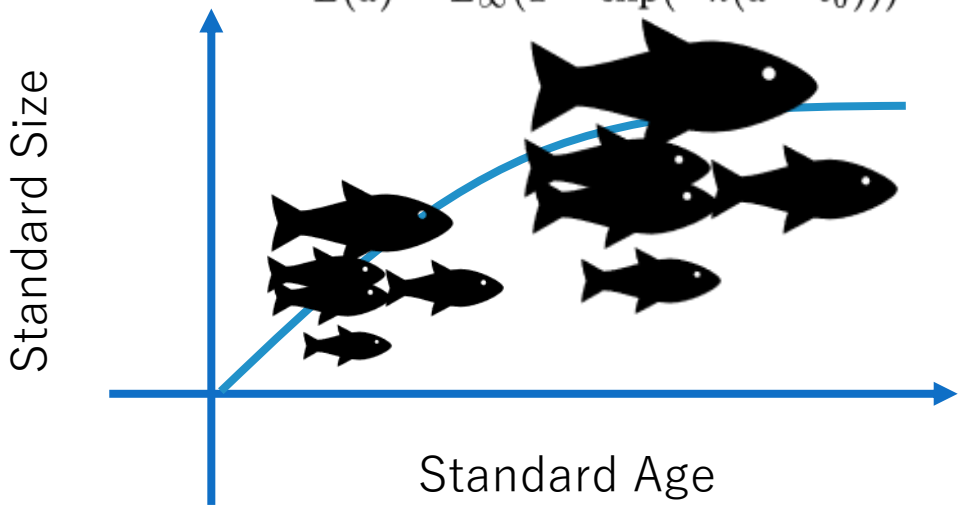
Solve the equation

Often iteration (simulation)

But **possible to FIND with HELPS!**

The size-based LB-SPR model

$$L(a) = L_\infty(1 - \exp(-k(a - t_0)))$$



We can approximate parameters from sizes!

SPR is

>20%...INCRESE!

=20%...MAINTAINED

<20%...DCRINING

- We can estimate Spawning Per Recruit (SPR: Spawning potential) as the reference point (e.g. Hordyk et al., 2015)
- Inputs:
  1. M/K ratio (natural mortality M / von Bertalanffy growth coefficient K),
  2. Mean Asymptotic Length $L\infty$,
  3. Descriptions of size at maturity specified as $L_{mat50\%}$ and $L_{mat95\%}$ = the sizes at 50 percent and 95 percent of the population mature
- Threshold 0.2 or 20% as the “standard” SPR

Size information collection is practical

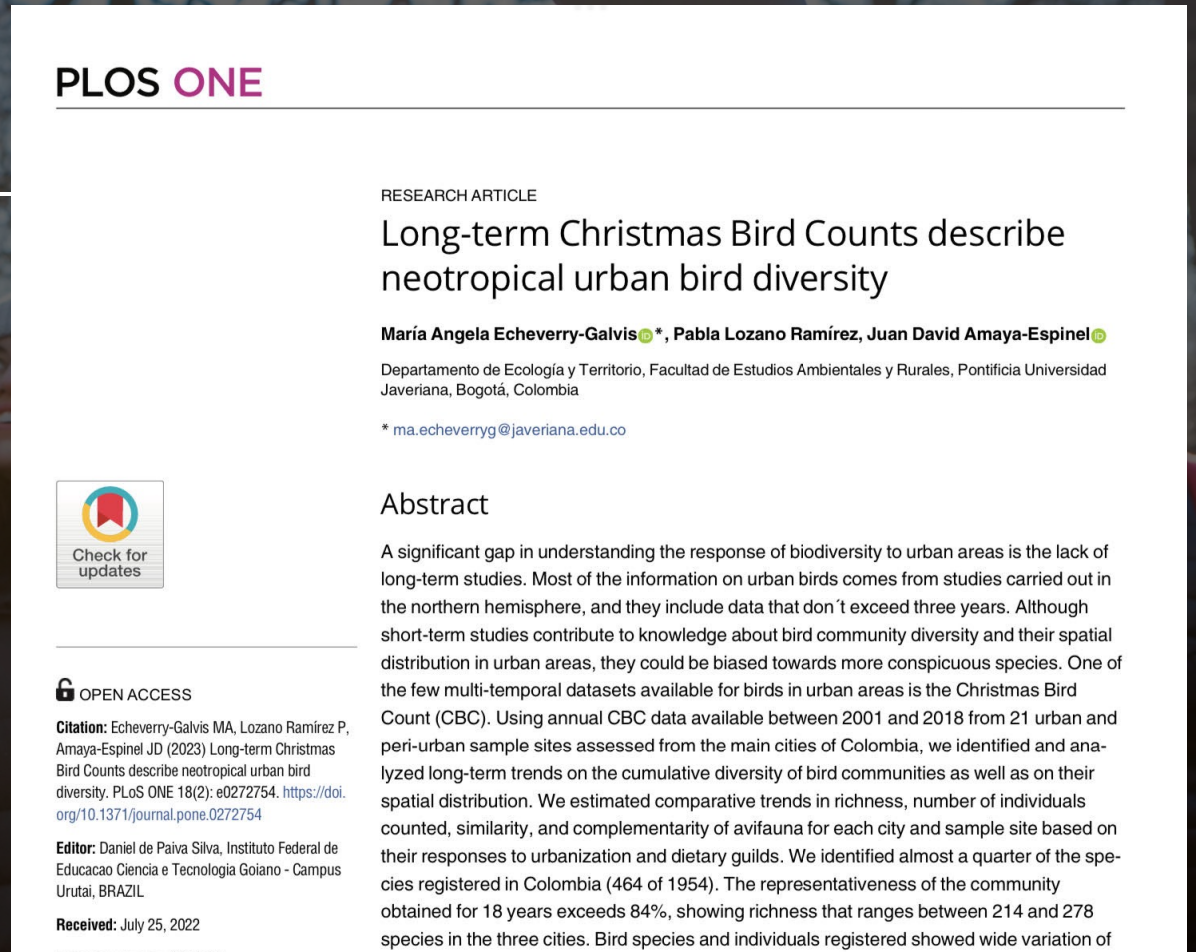
- And often with easy method
- Careful: it does not mean we can wave sampling design, statistical assumption/interpretation and uncertainties from ecological dynamics

Apply low-cost and low efforts method to collect data and information

- Christmas bird count (CBC)
  - Since Christmas in 1900 (25 counts)
  - National Audubon Society
    - Updating online

https://www.audubon.org/conservation/science/christmas-bird-count

Providing significant scientific papers



PLOS ONE

RESEARCH ARTICLE

Long-term Christmas Bird Counts describe neotropical urban bird diversity

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Check for updates

OPEN ACCESS

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Abstract

A significant gap in understanding the response of biodiversity to urban areas is the lack of long-term studies. Most of the information on urban birds comes from studies carried out in the northern hemisphere, and they include data that don´t exceed three years. Although short-term studies contribute to knowledge about bird community diversity and their spatial distribution in urban areas, they could be biased towards more conspicuous species. One of the few multi-temporal datasets available for birds in urban areas is the Christmas Bird Count (CBC). Using annual CBC data available between 2001 and 2018 from 21 urban and peri-urban sample sites assessed from the main cities of Colombia, we identified and analyzed long-term trends on the cumulative diversity of bird communities as well as on their spatial distribution. We estimated comparative trends in richness, number of individuals counted, similarity, and complementarity of avifauna for each city and sample site based on their responses to urbanization and dietary guilds. We identified almost a quarter of the species registered in Colombia (464 of 1954). The representativeness of the community obtained for 18 years exceeds 84%, showing richness that ranges between 214 and 278 species in the three cities. Bird species and individuals registered showed wide variation of

From our case studies

From Indonesia
INVOLVEMENT with Participatory approach in all processes

- Data collection was done by fishermen in the Project
  - Conventional
- 3rd Phase of the Project: Involving sightseeing sector

Advantage/disadvantage of the participatory approach

	ADVANTAGE	DISADVANTAGE
Research	Potentially low cost Potentially small efforts for sampling	Not always controllable in the design - Spatial and temporal biases for ecological information
Development	Information will be interactively shared - Enhancing public involvement in the topics/issues	

- **Data quality** is not up to the surveyors but the level of training (and trainers)
- Cost should be associated to the return- COST/BENEFIT is the criteria

Involvement with participation

- Participatory approach can enhance understandings and involvement
  - Learning from own experiences with own word
  - Teamwork
  - Involvement: “I am the part of the decision”

But, proper facilitation and sufficient information are necessary

Research and involvement

- In Indonesia, we diagnosed the situation around their production together
- On the other hand, suggested teamworks with communication s

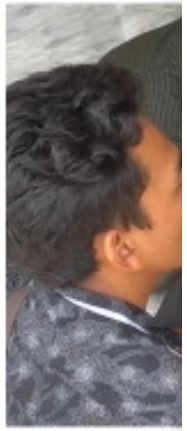
NO COMMUNICATION

ターン	1	2	3	4	5	6	7	8	合計
player1	2	3	4	2	3	3	2	1	20
player2	2	3	4	4	5	2	1	1	22
player3	2	2	2	3	4	4	4	2	23
player4	2	1	2	3	2	3	3	2	18
資源量	20	24	30	36	48	68	112	204	
player5	2	2	3	4	2	3			16
player6	3	2	1	2	2	2			12
player7	3	1	1	2	2	2			11
player8	4	2	4	3	3	3			19
資源量	20	16	18	18	14	10	0		

Wills of conservation and cooperation

WITH COMMUNICATION

ターン	1	2	3
player1	0	0	2
player2	1	0	0
player3	1	0	2
player4	0	1	0
資源量	20	36	70
player5	1	1	0
player6	1	2	1
player7	1	1	3
player8	1	0	1



Before

COMPETENCY AS A GROUP WAS HIGH!

Unfo

In my case study 1

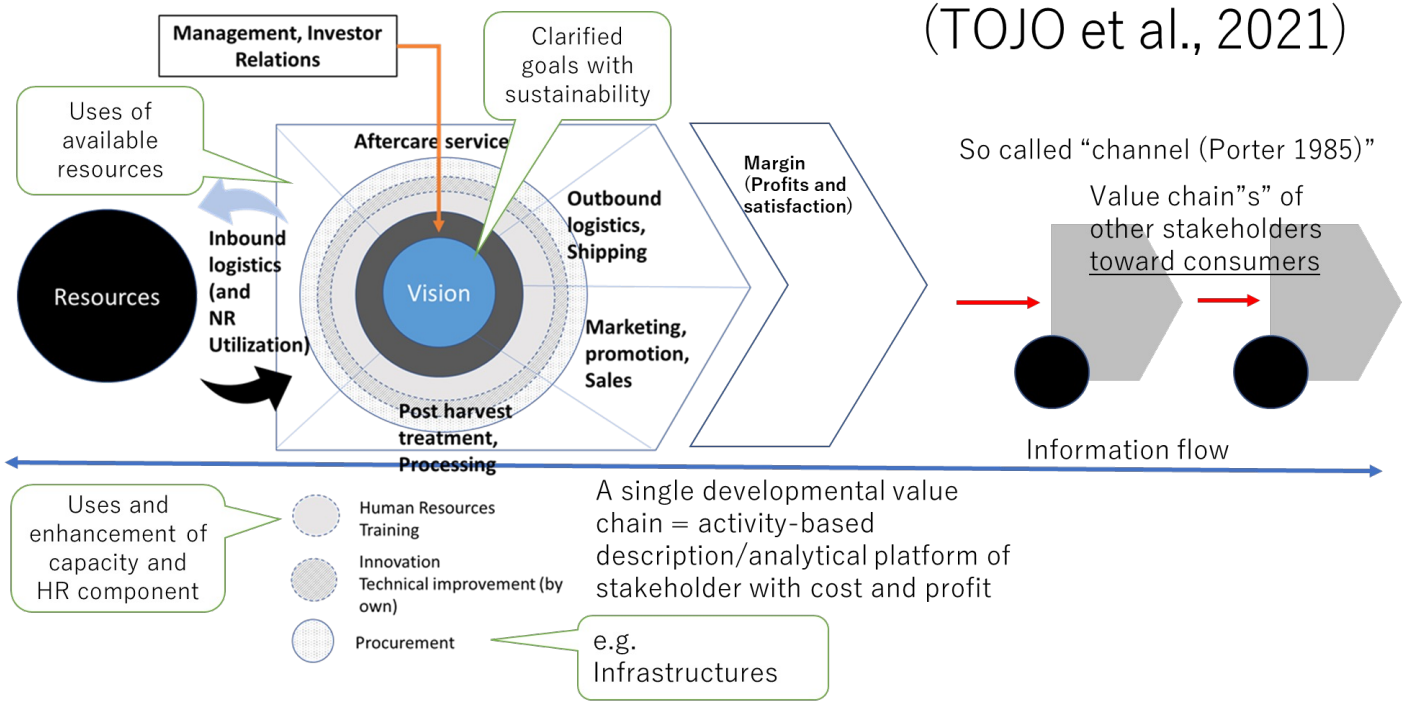
- With fishermen and fisherwomen, also their kids, HOKKAIDO UNIVERSITY team is now collecting the size information for local fish stock status monitoring in Mauritius
- Encouraging own interests with understandings among locals

In my case study 2

www.fishbase.org

https://www.nytimes.com/2009/07/31/world/asia/31lanka.html

Developmental Value Chain platform (TOJO et al., 2021)

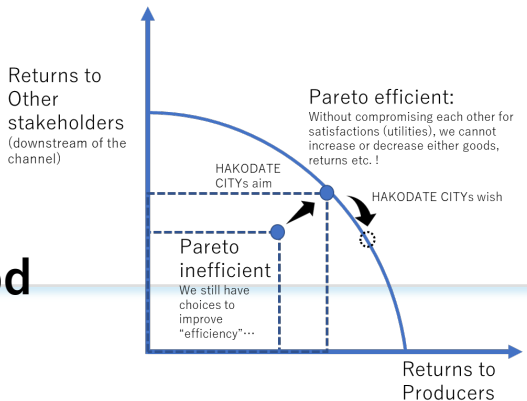


- We are now describing the status of the Value Chain in Sri Lanka
  - Then find realistic measures for sustainable and effective uses of small pelagic species
  - At this moment, focusing fishermen

From focus group meeting activity in Sri Lanka

- **Combination of participatory approach and application of iteration (simulation) to compare likelihood**

$$\mathrm{EE}_i = \frac{\pi_i}{\pi_{\max}} = \frac{f(P_i, Z_i)e^{v_i - u_i}}{f(P_i, Z_i)e^{v_i}} = e^{-u_i}$$



+ Applying Bayesian for extrapolation?