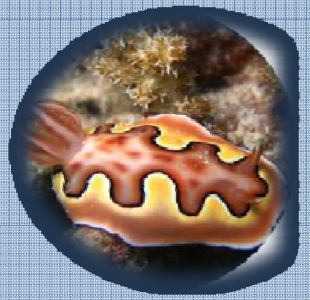
Discount Rates in Small-Scale Fisheries

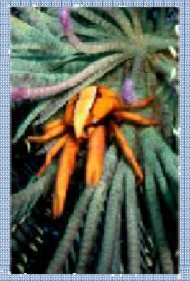
LOUISE TEH

IN HONOUR OF DR. COLIN CLARK CONFERENCE

UBC, MAY 15, 2012

CORAL REEFS





Picture by Achar ©

Reef Fisheries

- Small-scale, multi-species & multi-gear;
- Extensive overexploitation;
- Over 55% of coral reefs worldwide threatened by overfishing and destructive fishing (Burke et al. 2011).

Reef Guardian

Threatened coral reef species

Reef Guardian

Chris Johnson, Odyssey

Discount rates and fisheries sustainability

How willing are fishers to sacrifice their current fishery benefits in order to enjoy higher benefits in the future?

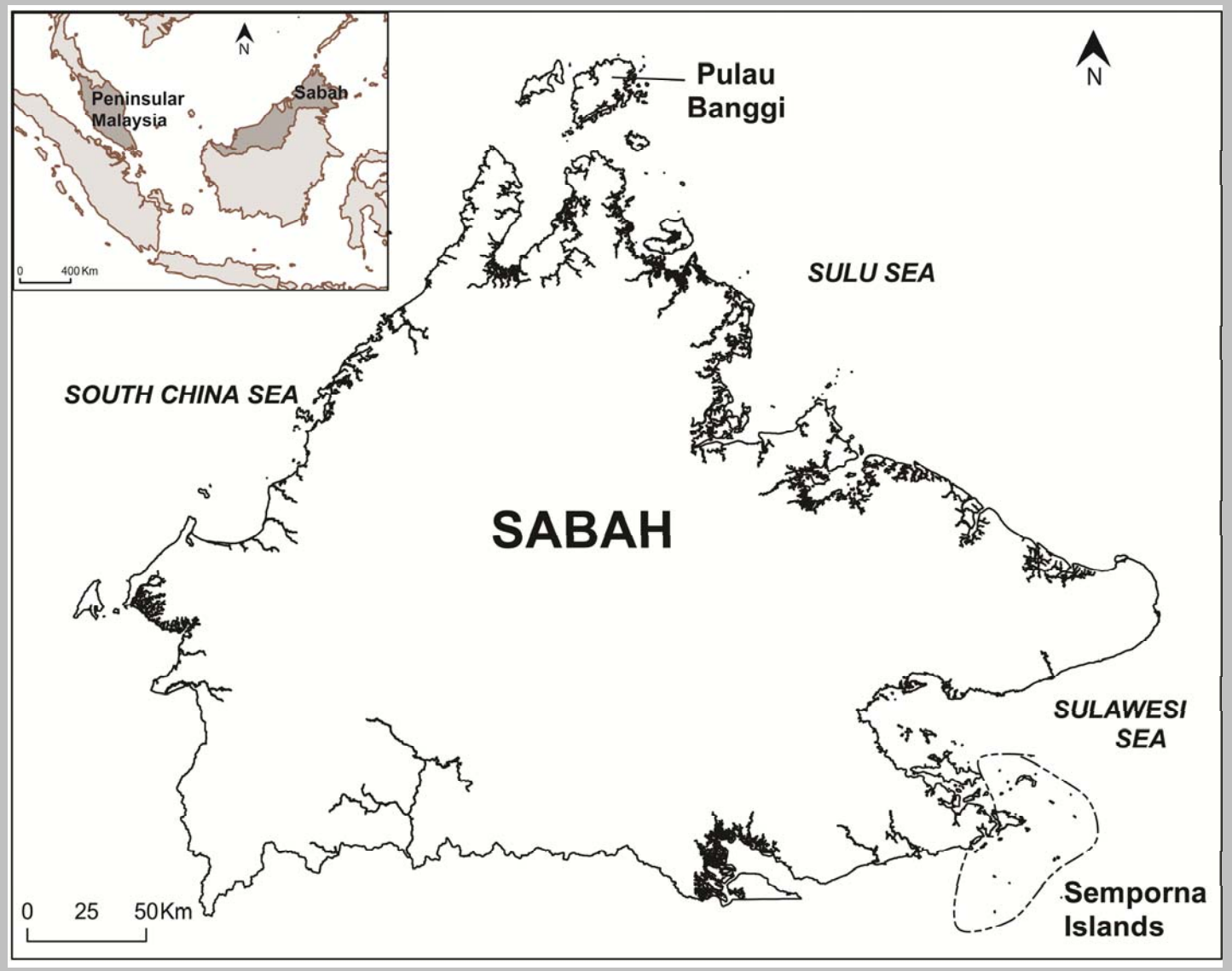
Discount rates and fisheries

- Private discount rate measures one's willingness to forgo immediate benefits in order to enjoy future, bigger benefits;
- Discounting affects long term sustainability of fisheries resources (Clark 1973, Sumaila 2004);
- Few empirical studies:
  - High discount rates increased intensity of violating fisheries regulations (Akpalu 2008);
  - Low discount rates associated with less intense fishing pressure (Fehr & Liebbrandt 2008).

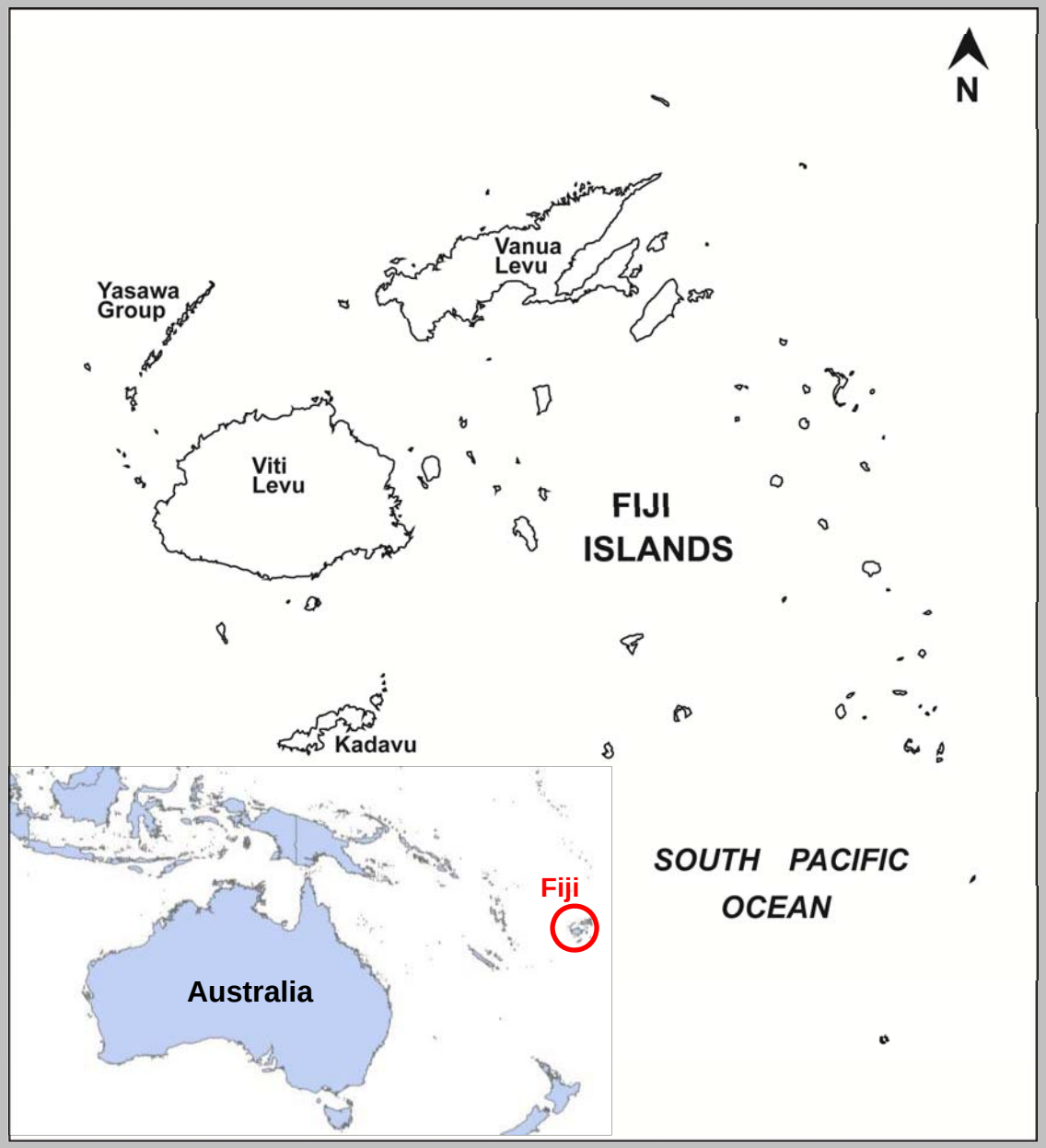
Research Questions

1. What are the private discount rates of small-scale fishers?
2. Under what socio-economic conditions do fishers have low discount rates?
3. Are discount rates reflective of fishery exploitation status?

Study site 1


N
Peninsular Malaysia
Sabah
0 400 Km
Pulau Banggi
SULU SEA
SOUTH CHINA SEA
SABAH
SULAWESI SEA
Semporna Islands
0 25 50Km

Study site 2


N
Vanua Levu
Yasawa Group
Viti Levu
FIJI ISLANDS
Kadavu
SOUTH PACIFIC OCEAN
Fiji
Australia

Fishing Villages

Discount rates of fishers in open access and traditionally managed reef fisheries

Open access (Sabah):

- No assurance of future benefits from the fishery;
- Forced to entirely discount the future, i.e., use a discount rate of infinity (Clark, 1990).

Customary marine tenure (Fiji):

- Traditional management of fishing grounds;
- Stewardship of marine resources – lower discount rate.

Teh et al. (submitted)

Eliciting discount rates

- Semi-structured interviews:
  - 75 interviews in Sabah (April/May 2009)
  - 45 interviews in Fiji (May/June 2008)
- Binary choice series using hypothetical payments:
  - Choose between an immediate, smaller payment or delayed, larger payment

Estimating Discount Rates

Now ($)	1 month ($)	Discount rate (annual%)
100	105	29
100	110	86
100	115	141
100	120	193
100	125	243
100	130	291
100	135	337
100	140	381
100	145	424

Discount Function:

$$r = \ln(x/y)/t$$

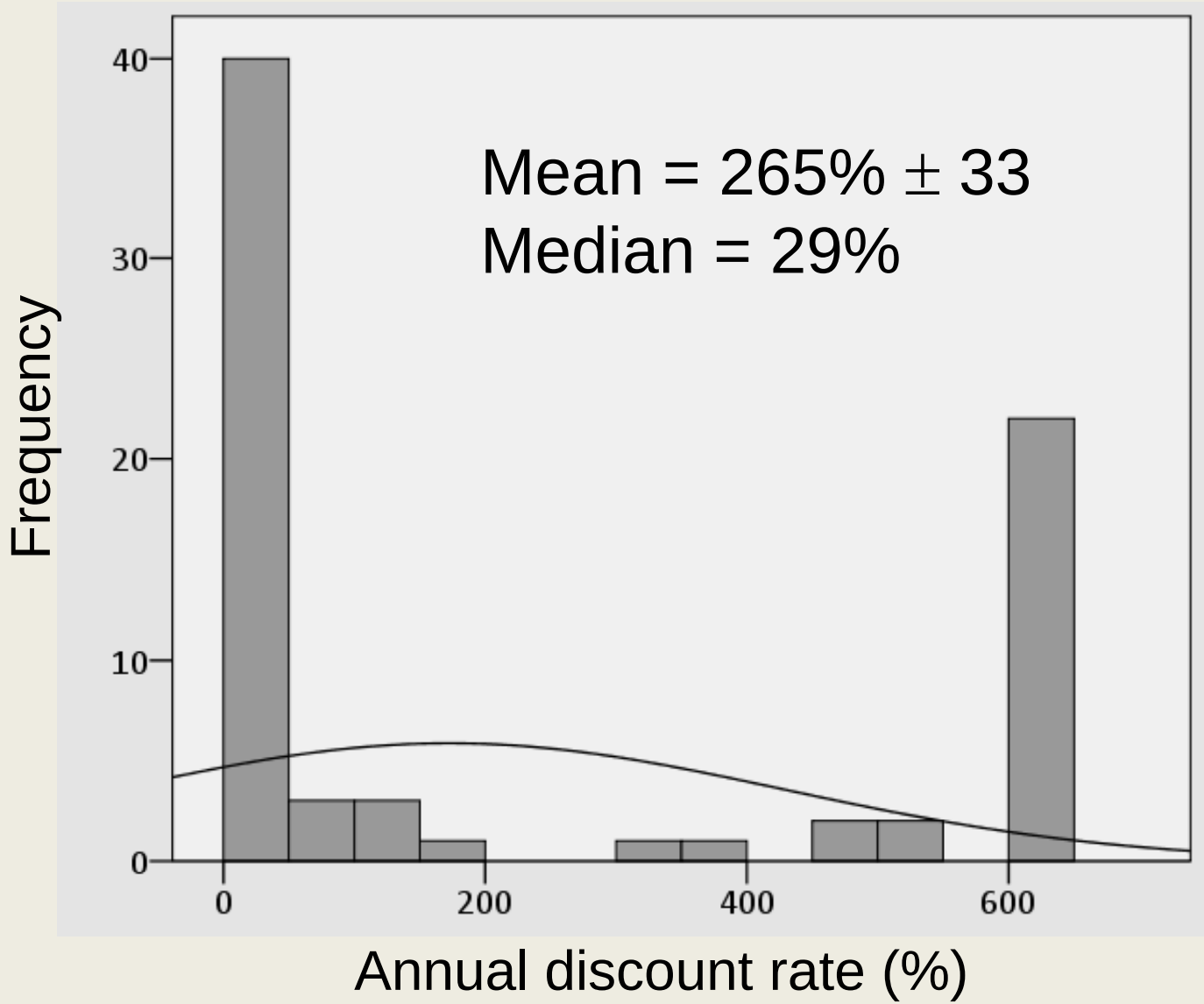
r = discount rate

y = present value

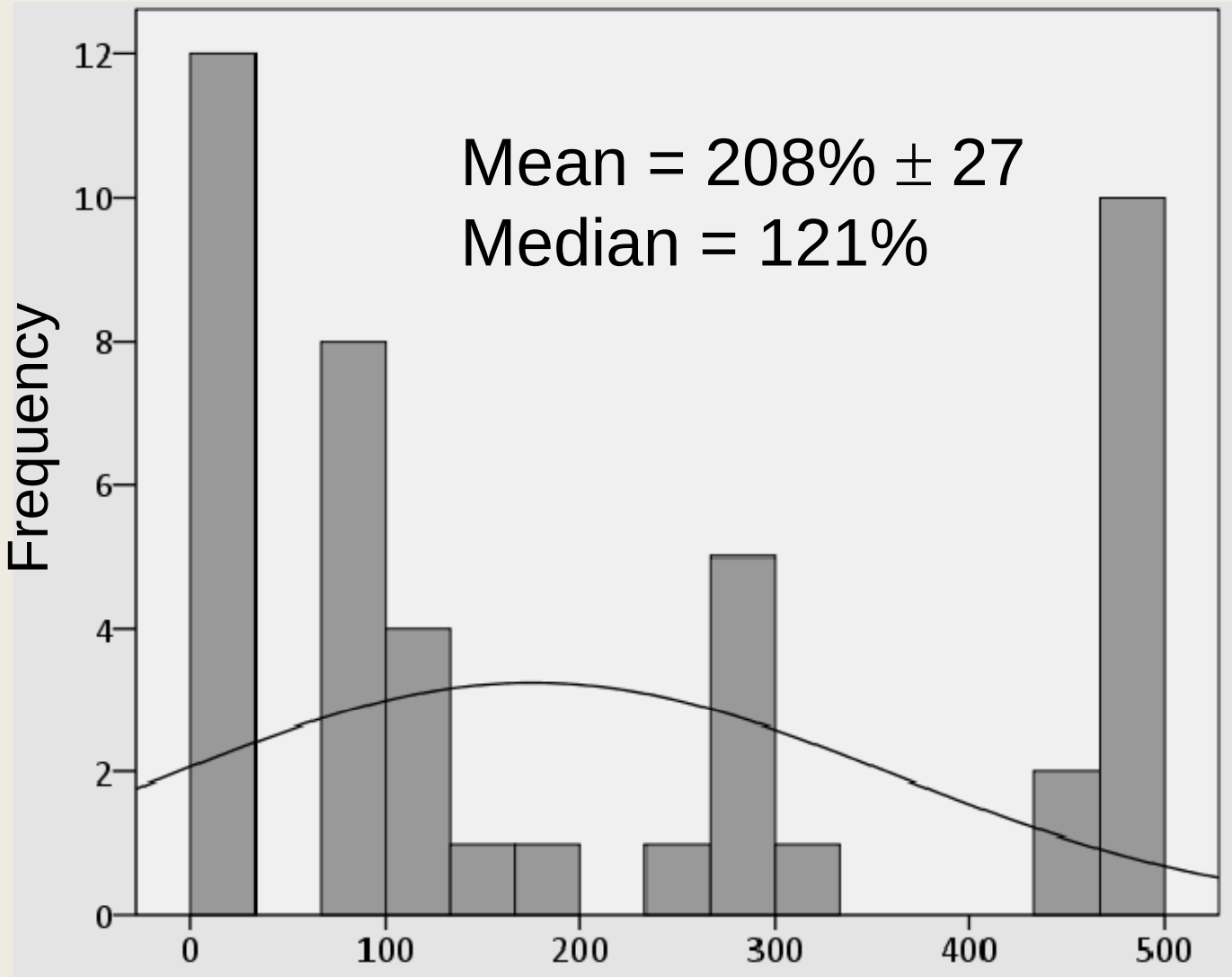
x = future value

t = time delay

Discount rates of fishers in Sabah for 1 month delay



Discount rates of fishers in Fiji for 1 month delay



Proportion of fishers choosing each choice option by site

	Sabah (%)	Fiji (%)
'Impatient'	30	20
'Patient'	51	27
Other	19	53
Patience proxy (=r_i/r_{max})	0.39*	0.44

*$p<0.05$

Percentage of respondents at each village who chose the ‘patient’ option

Village	Site	%
Sibogo Balak	Banggi	14
Mabul	Semporna	20
Dogoton	Banggi	38
Hampalan Laut	Semporna	40
Damaran	Banggi	67
Omadal	Semporna	67
Batu Sireh	**Banggi**	**70**
Sibogo Air	Banggi	71
Manawali	**Banggi**	**83**
Maligu	**Banggi**	**100**

Defining a low discount rate

Now ($)	1 month ($)
100	105
100	110
100	115
100	120
100	125
100	130
100	135
100	140
100	145

Low discount rate = Choosing smallest future payment offered

All other choices = non-low discount rate

Logistic regression model

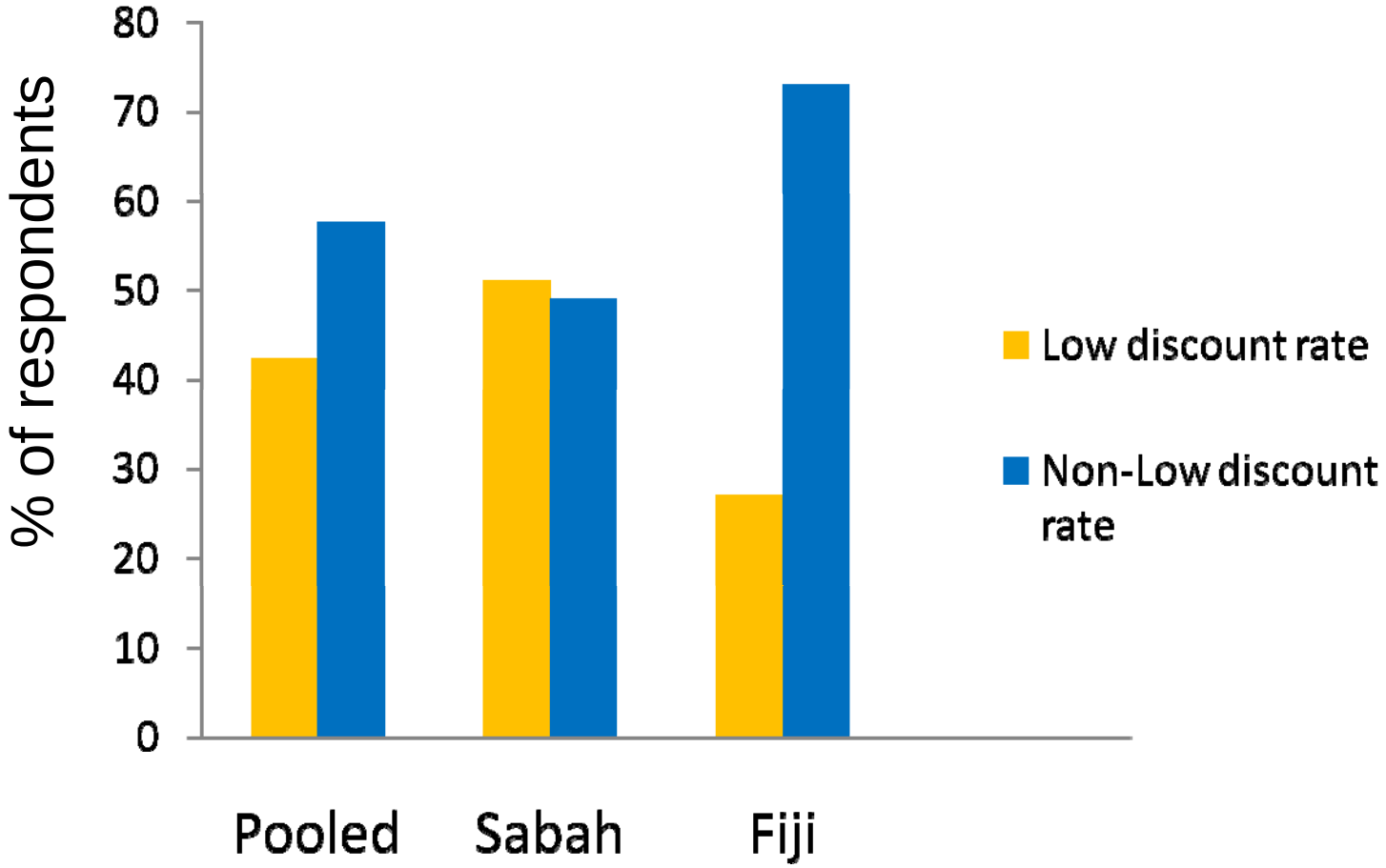
Identify which socio-economic factors predict the probability that a fisher chooses a low discount rate

$$Y = \alpha + \beta X + \gamma Z + \delta W + \varepsilon$$

Y = Probability of choosing a low discount rate
X, Z and *W* = matrices of demographic, socio-economic and location variables

3 models:
(i) pooled (n=118)
(ii) Sabah only (n=73)
(iii) Fiji only (n=45)

Prevalence of low discount rates among small-scale fishers



Logistic regression output

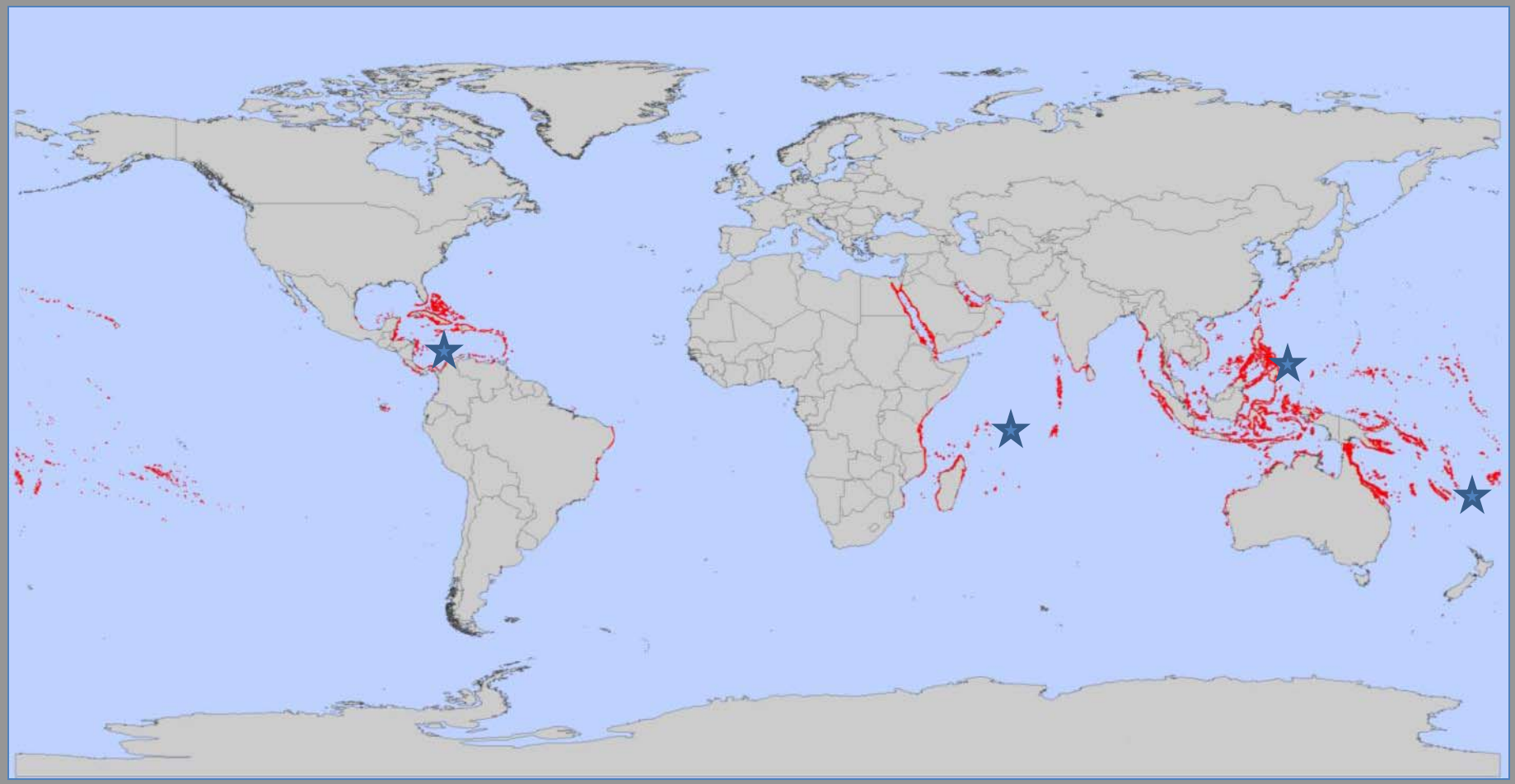
Significant predictors of low discount rates among fishers

Variable	Pooled	Sabah	Fiji
Protection	+	+	
Site	+		
Boat ownership		+	-
Relative catch		-	+

+ Increases likelihood of a fisher choosing a low discount rate
- Decreases likelihood of a fisher choosing a low discount rate

Teh et al. (2011) Sustainability

Coral reefs worldwide



● Coral reefs

Economics of overexploition

Theory: Even under restricted access, the sole owner of a fishery has an incentive to deplete the resource if their discount rate δ satisfies the condition

$$\delta > 2r$$

where r = intrinsic population growth rate of the fish stock (Clark 1973).

Data

1. Economic

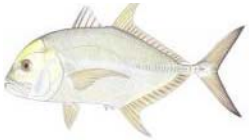
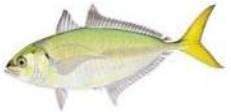
Discount rates

- Managers = official discount rate (δ)
- Fishers = private discount rate (δ_p)

2. Biological

Intrinsic growth rates

- Species level (r_s)
- Fishery level (r_f)

Species	r_s	% of catch
	0.5	5
	0.6	20
	1.0	10
	0.4	15
	0.5	5
	0.2	15
	1.8	22
	2.2	5
	0.3	3

Fishery level r_f

0.875 yr^{-1}

Comparing discount rates to exploitation status

Status*	Official discount rate (δ)
Underexploited	$\delta < r_f$
Overexploited	$\delta > r_f$
Depleted	$\delta > 2r_f$

r_f : Fishery level intrinsic growth rate

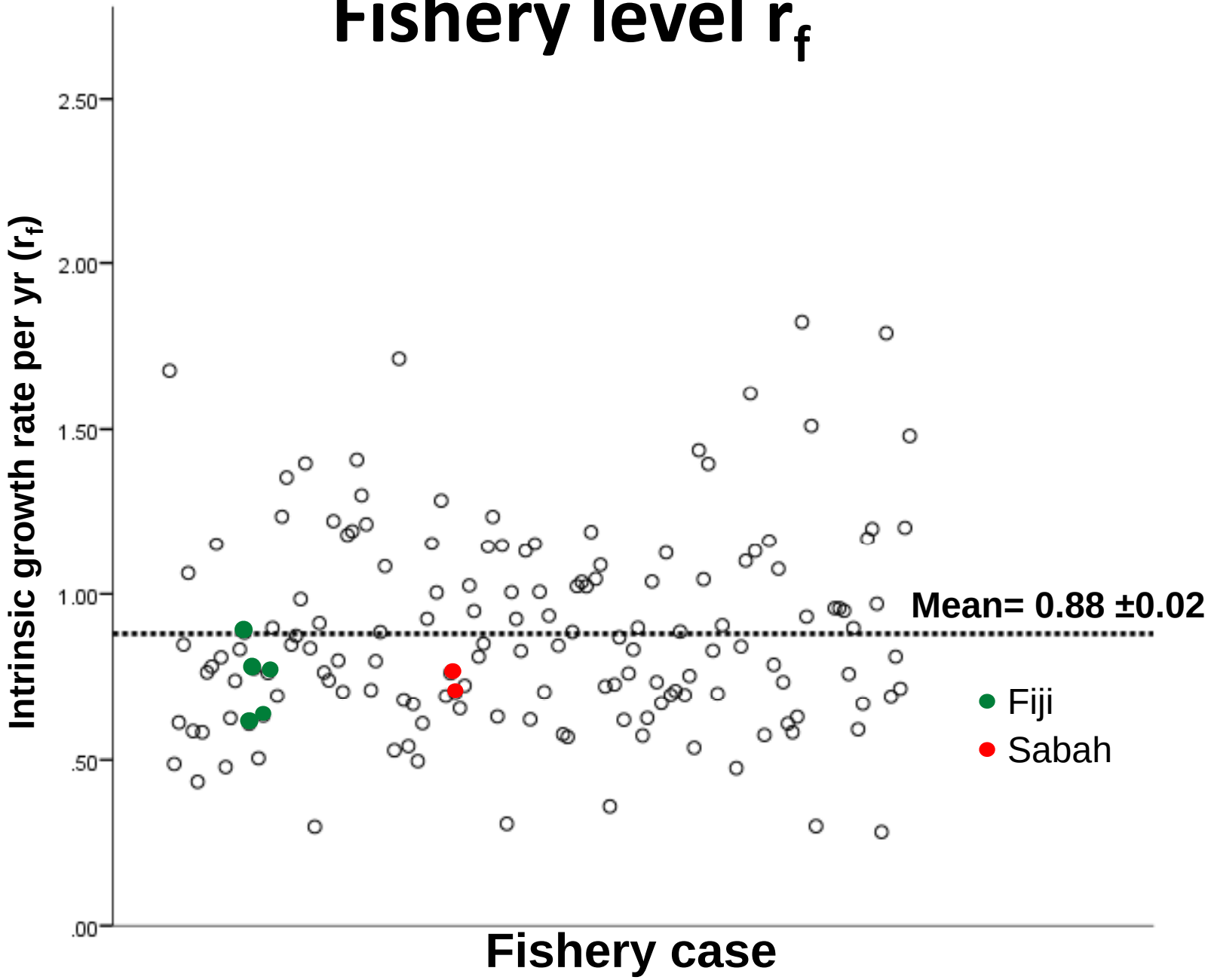
* Source: Newton et al. 2007 *Current Biology*

Inferring private discount rates

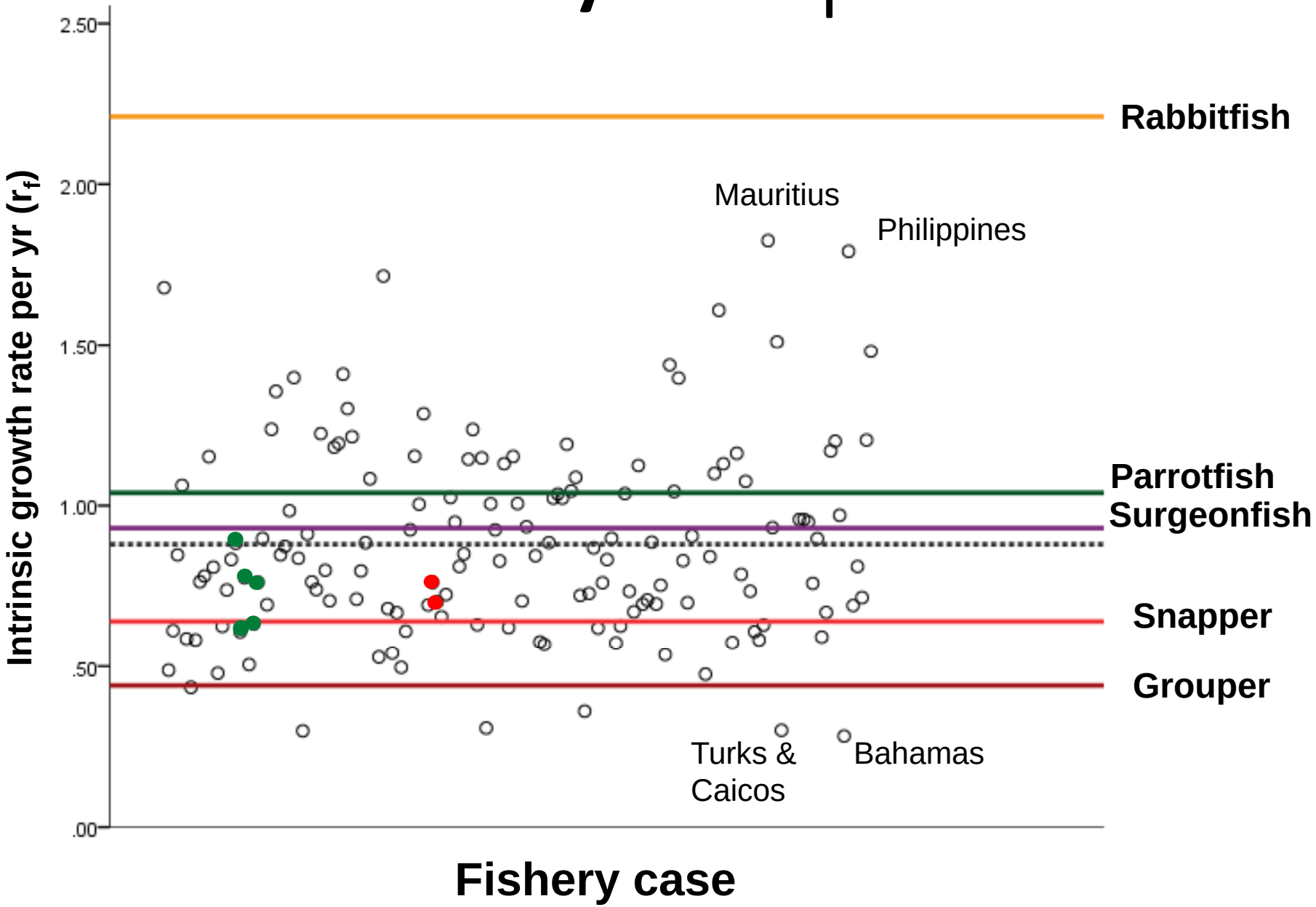
Status	Private discount rate (δ_p)
Underexploited	$0.29^* < \delta_p < r_f$
Overexploited	$r_f < \delta_p < 2r_f$
Fully exploited	$\delta_p = r_f$

* Minimum discount rate from Fiji and Sabah case studies

Fishery level r_f

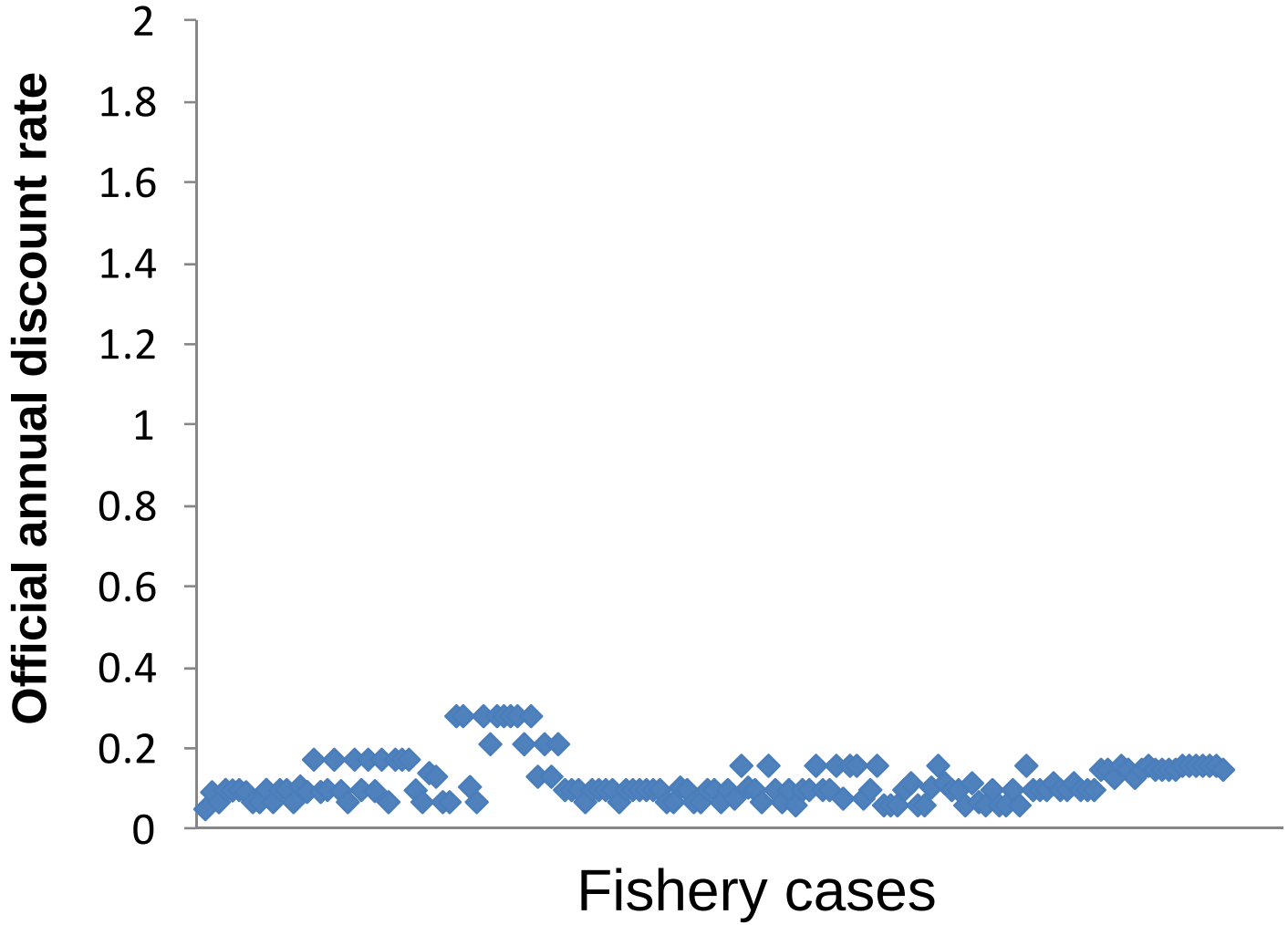


Fishery level r_f

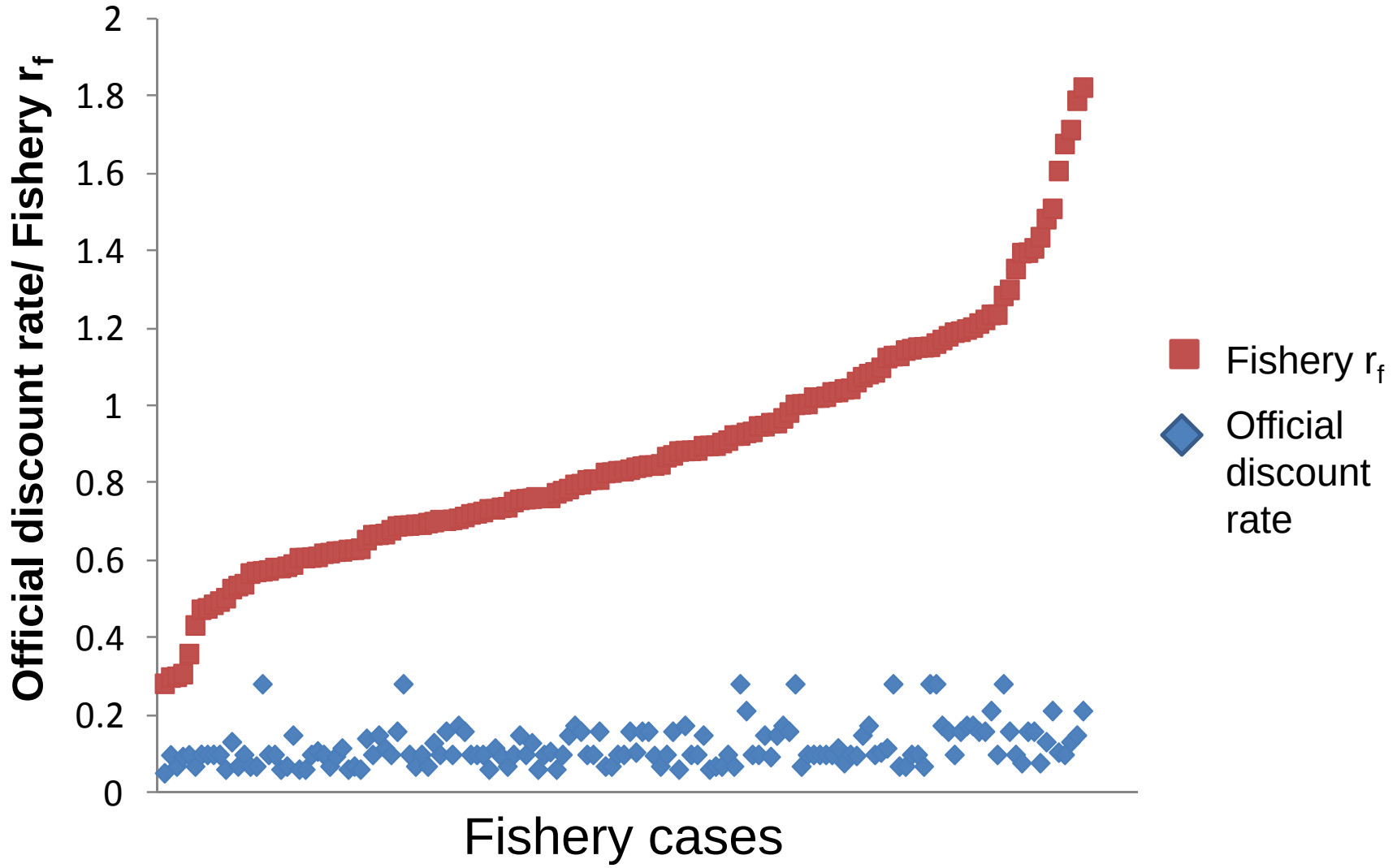


Teh et al. (submitted)

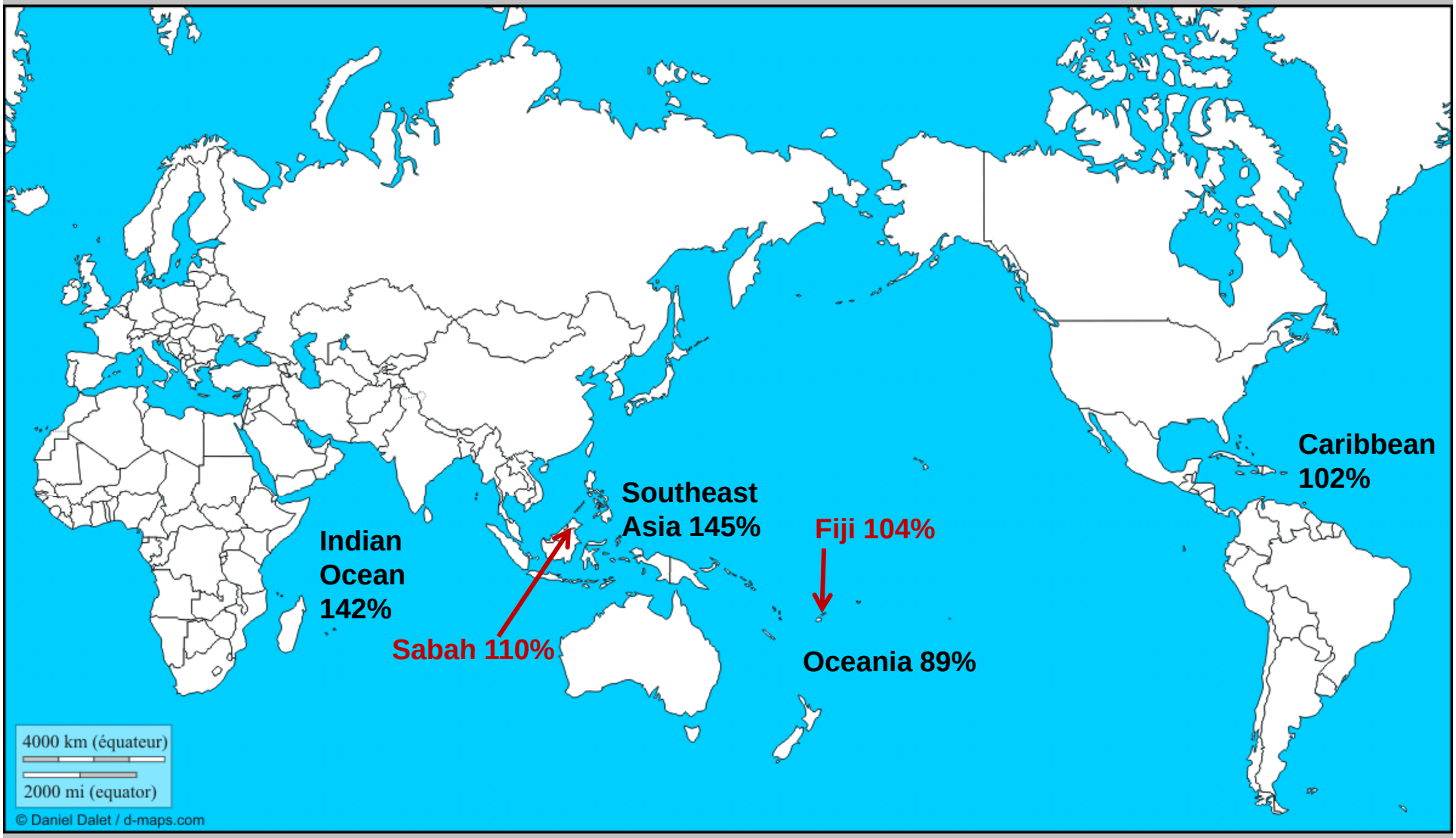
Official discount rates



Official discount rate vs. fishery r_f

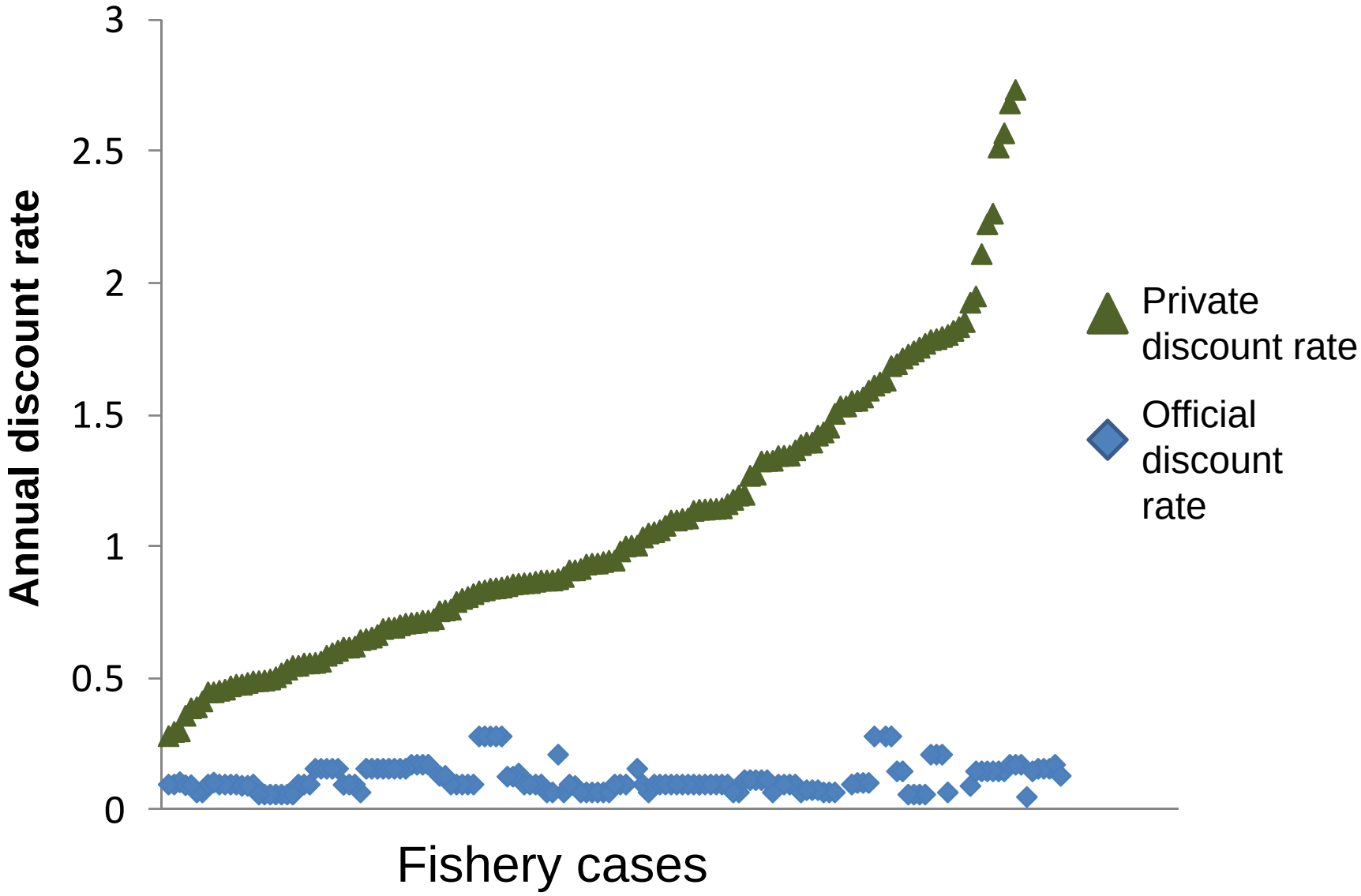


Inferred private discount rates



Overall mean = 107%

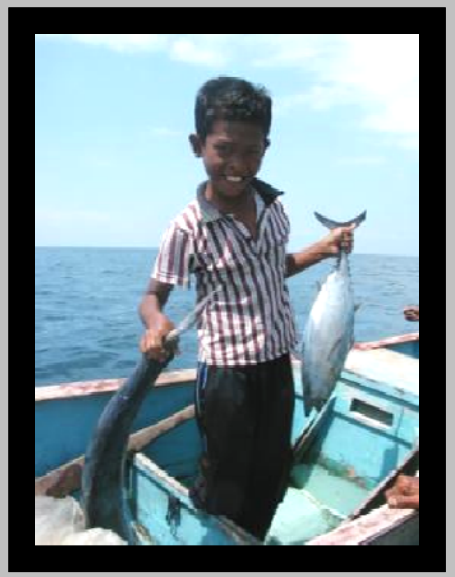
Official vs. private discount rates



Concluding Remarks

Need to start paying attention to fishers' discount rates

- Acknowledge fishers' short time perspective
- Better understanding about why fishers discount the way they do



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In the field: Lydia Teh, Prof. Dr. Ridzwan Abdul Rahman, UMS Seaweed Project staff (Banggi) ,WWF team (Kudat & Semporna), Nanise Kuridrani, Vily Tuiwakaya and Fiji Fisheries Department

Funding: SSHRC, Kingfisher Foundation, Cosmos International Graduate Travel Award (UBC)

All the fishers who made this research possible… *Maksukul, Terima kasih, Vinaka*

Estimating intrinsic population growth rate

- Based on Euler-Lotka method (McAllister et al. 2001)

$$\sum_{a=0}^{A} e^{-r \cdot a} \cdot l_a \cdot m_a = 1$$

- Solve for *r* iteratively using a numerical minimisation function
- Assume Beverton-Holt recruitment function, expressed as a function of the steepness parameter h