

# Lifetime displacements of tropical tunas:

How much ocean do you need to  
control to conserve “your” tuna?

John Sibert

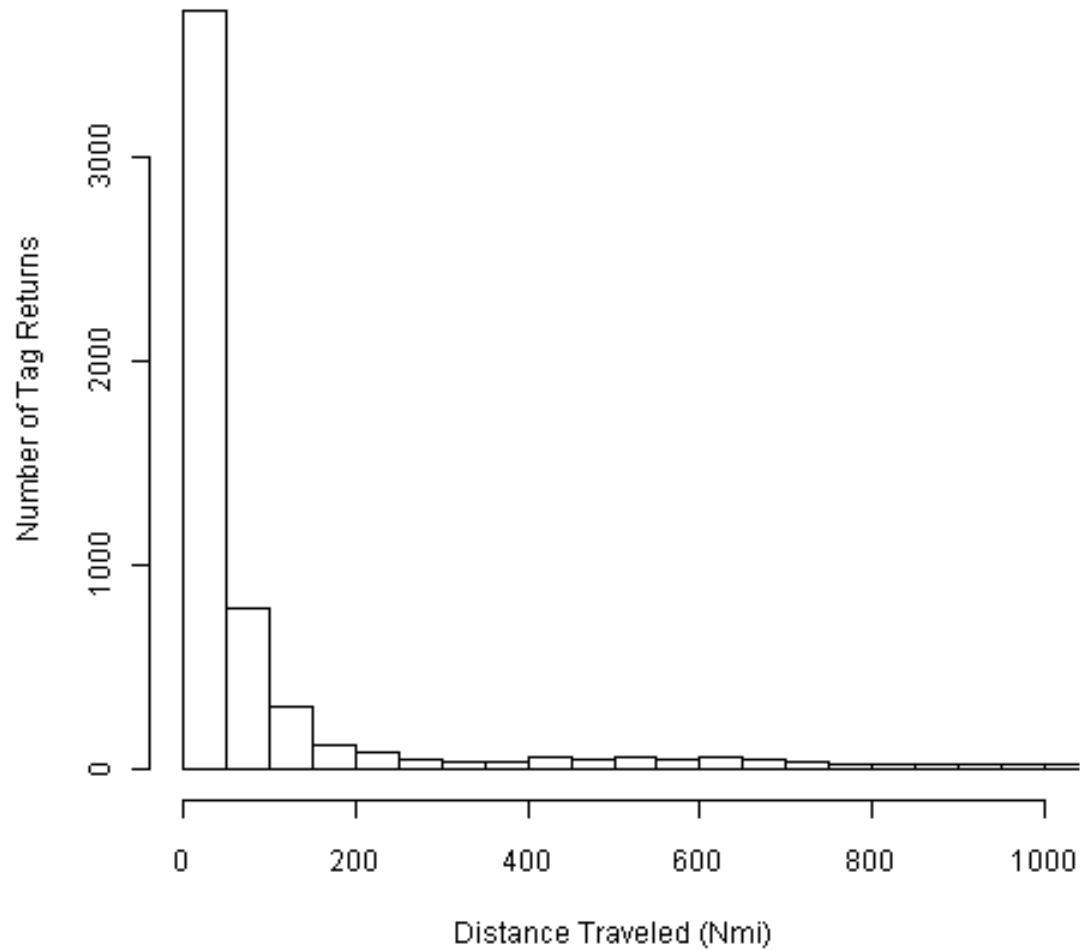
University of Hawaii, PFRP

John Hampton,

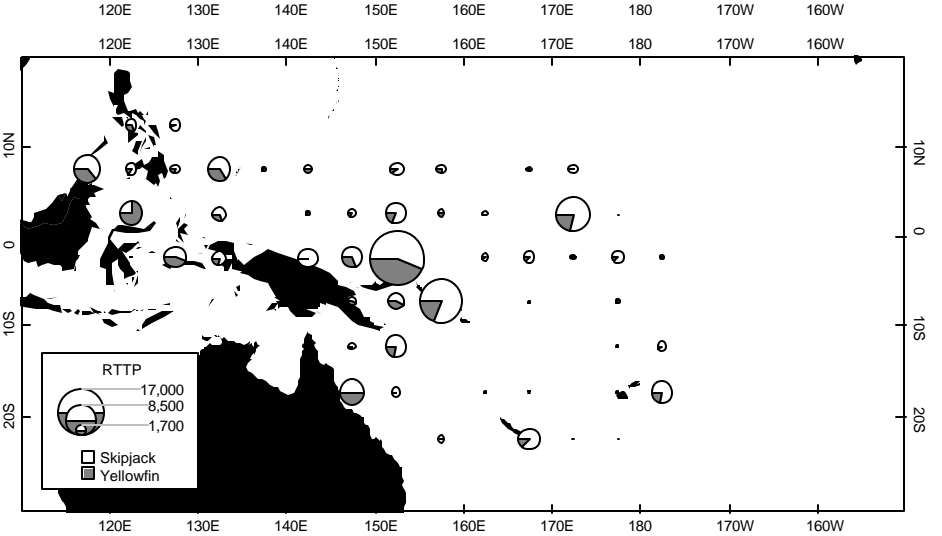
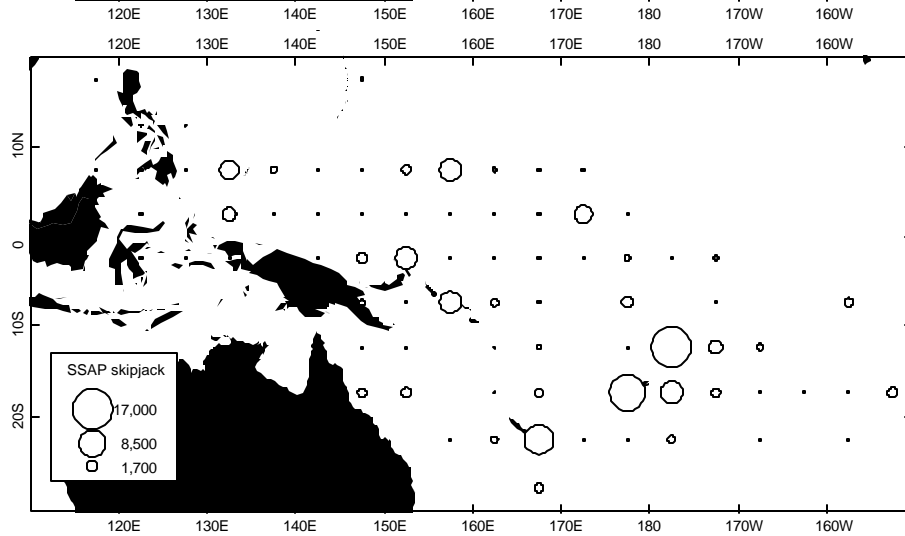
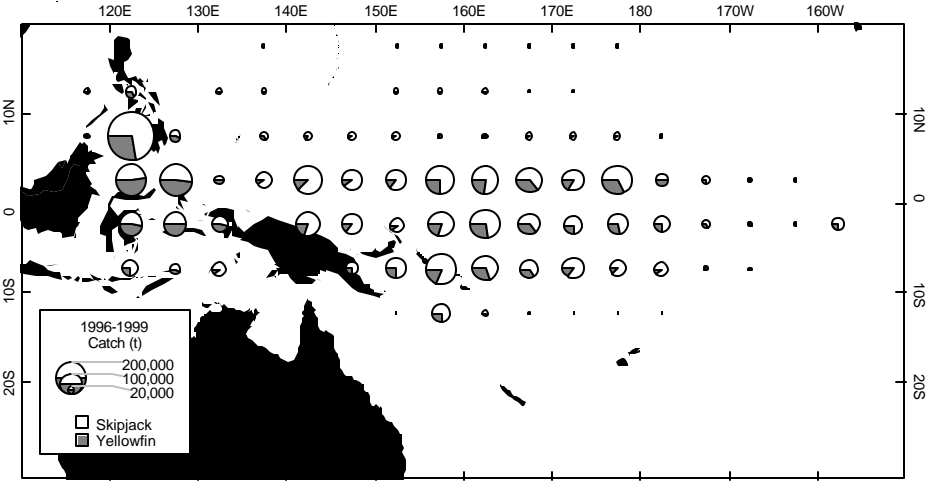
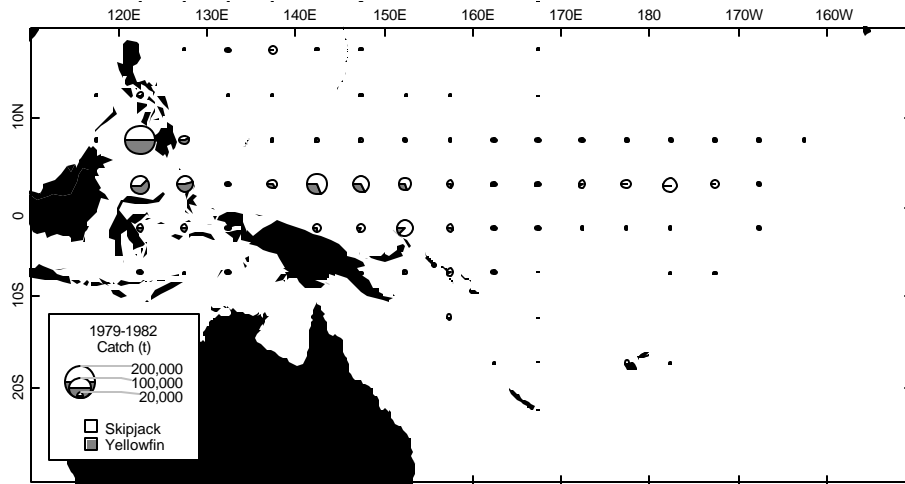
SPC, Noumea

# Highly Migratory?

SSAP Skipjack (28.47 NMi)

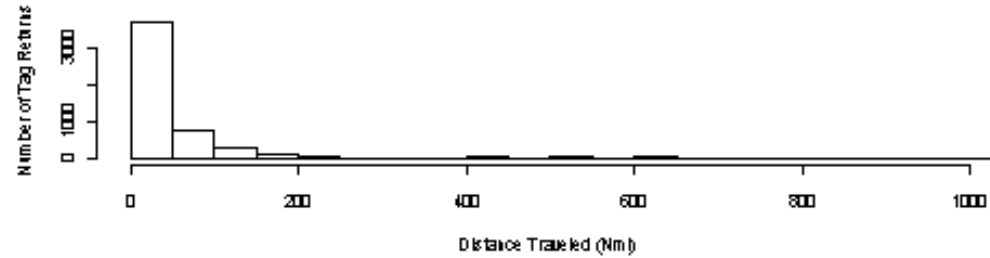


# 1970s vs 1980s

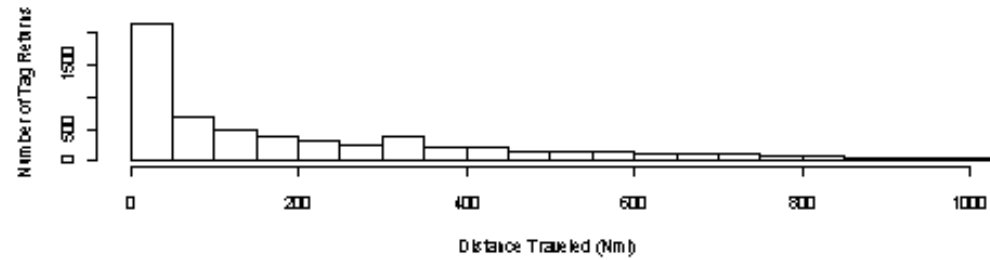


# Empirical Displacements

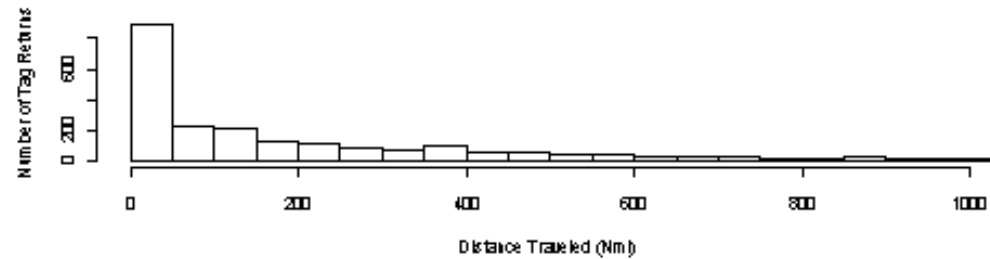
**SSAP Skipjack (28.47 NMI)**



**RTTP Skipjack (158.055 NMI)**



**RTTP Yellowfin (132.19 NMI)**



# Spatial Model

## Dynamics of tagged fish

$$\frac{\partial N}{\partial t} = \frac{\partial}{\partial x}(uN) + \frac{\partial}{\partial y}(vN) - \frac{\partial}{\partial x}\left(D\frac{\partial N}{\partial x}\right) - \frac{\partial}{\partial y}\left(D\frac{\partial N}{\partial y}\right) - ZN$$

Directed Movement

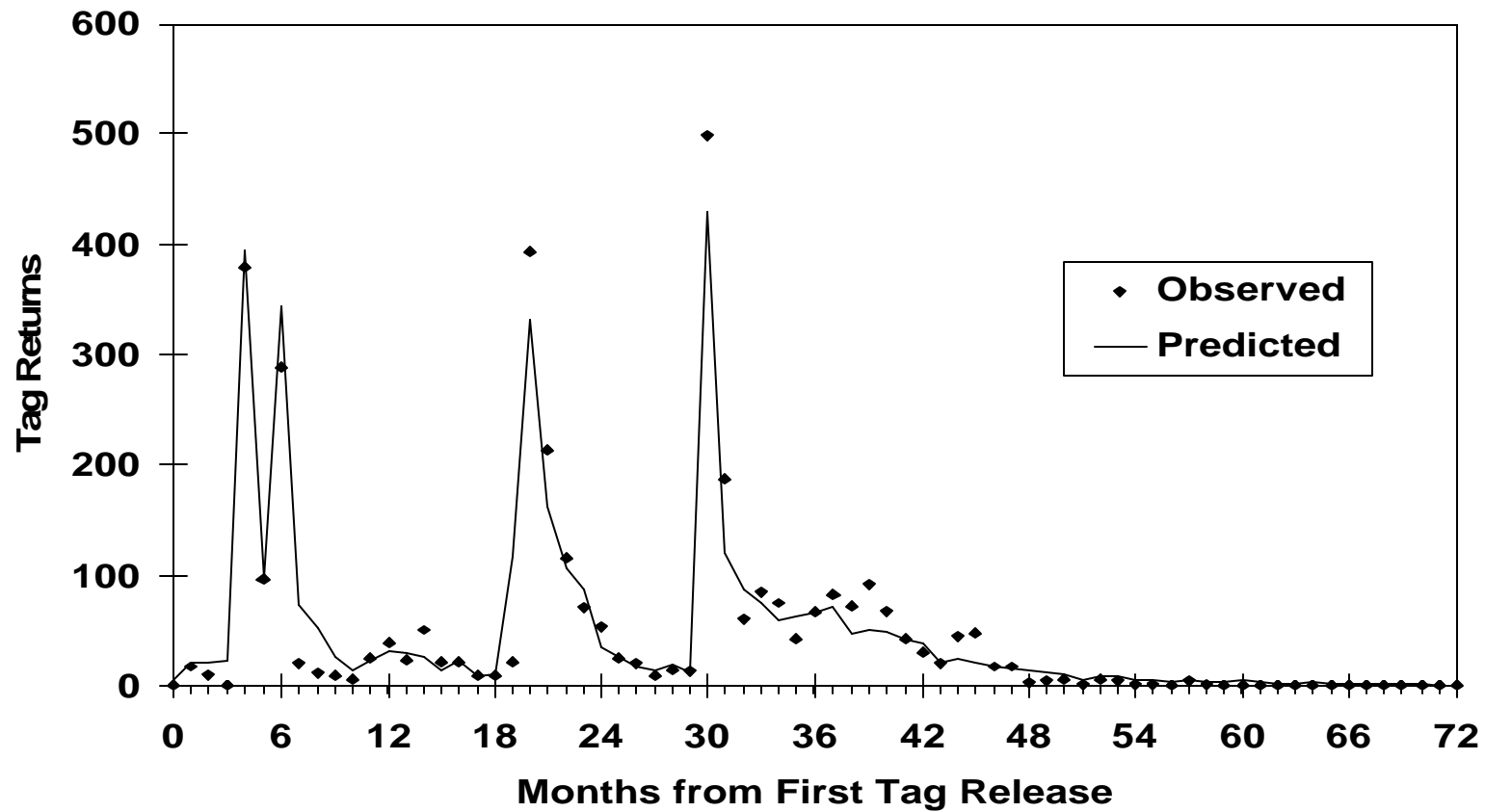
Dispersive Movement

Mortality

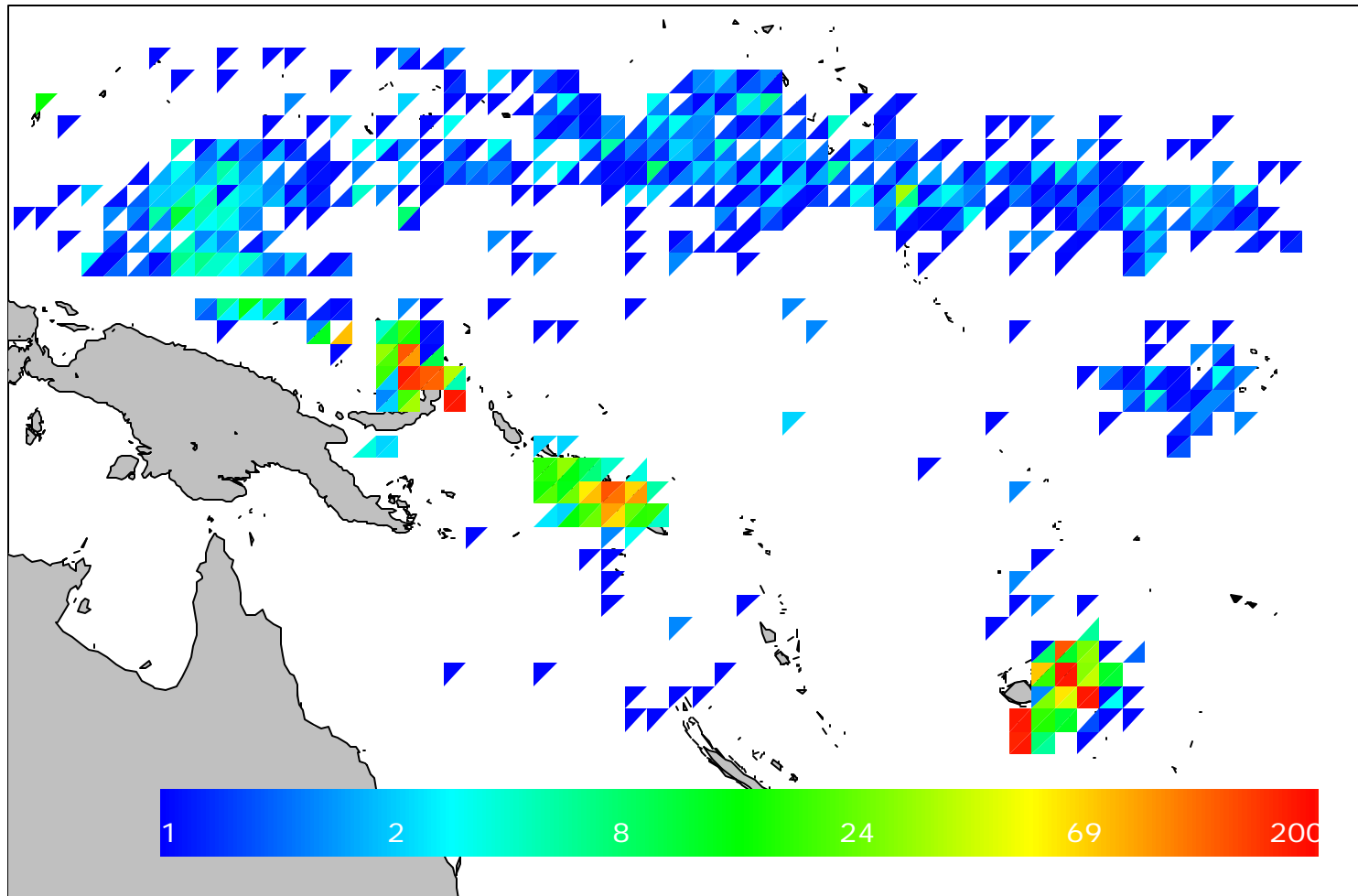
## Tag return dynamics

$$\hat{C}_{ij}^n = \mathbf{b}_f Q_f E_{ij}^n N_{ij}^n$$

# Time of Recapture (SSAP)



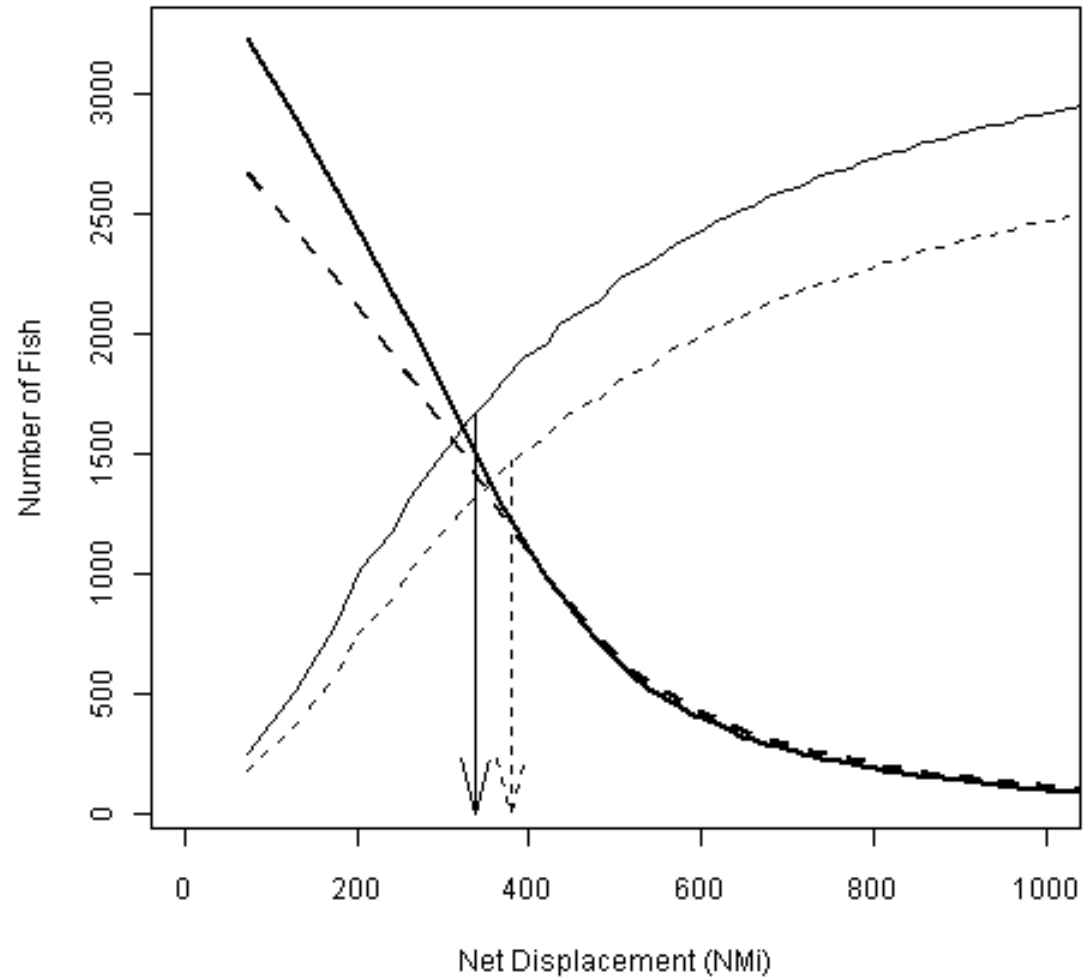
# Recapture Locations (SSAP)



# Mortality Changes

	SSAP	RTTP	
	skipjack	skipjack	yellowfin
	Natural Mortality		
Region	0.111	0.118	0.108
Philippines			0.128
	Fishing Mortality		
Fleet			
PNG P&L	0.00175		
Fiji P&L	0.00027	0.00041	0.00016
Japan P&L	0.00441	0.00253	
Kiribati P&L		0.00003	
Solomon Islands P&L	0.00133	0.00149	
Japan PS	0.00094	0.01057	0.00991
Korea PS		0.01778	0.01052
Philippines PS		0.00169	0.00129
Solomon Islands PS		0.00096	0.00126
Taiwan PS		0.00802	0.00700
United States PS		0.00785	0.00706
Sum F	0.00870	0.05132	0.03720
Total Z	0.12019	0.16921	0.14501

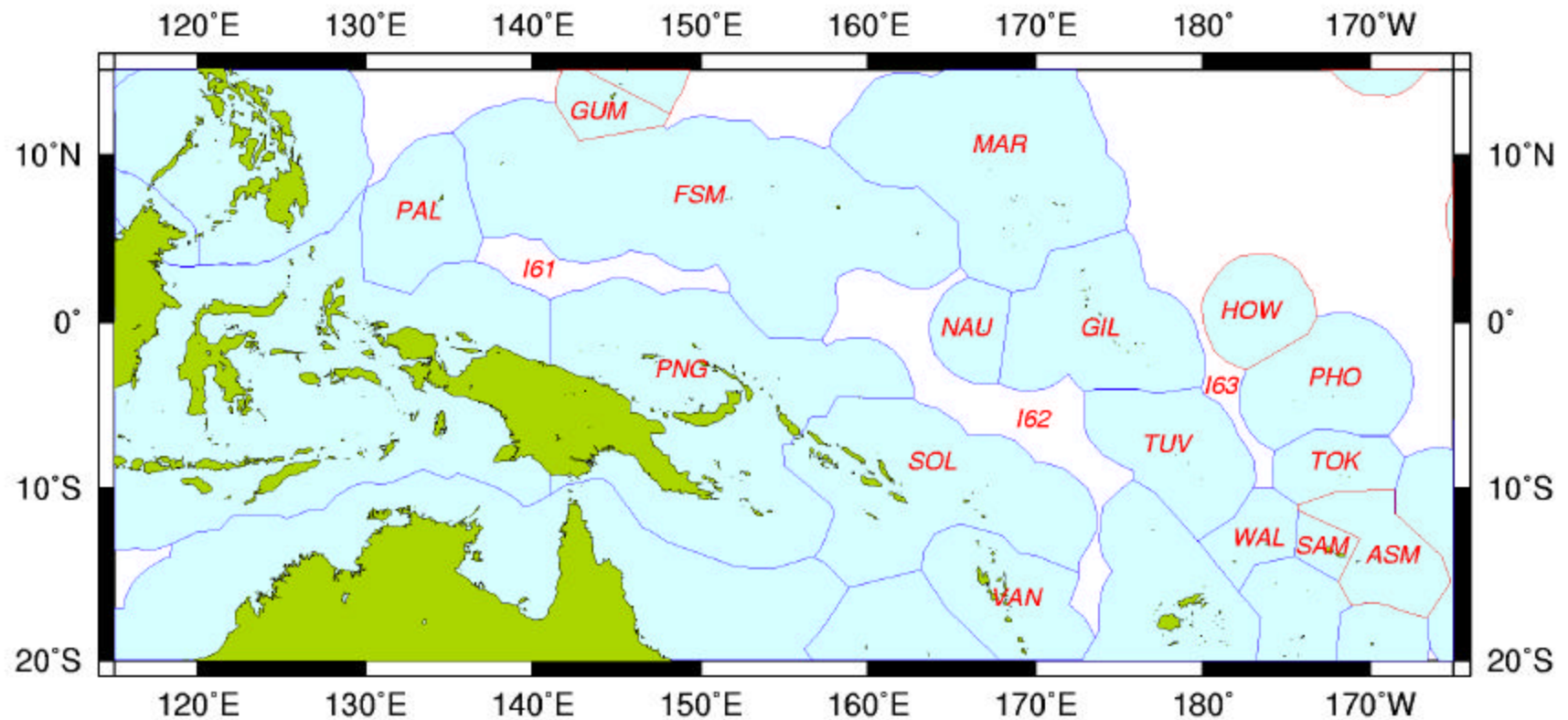
# Model Yellowfin Displacements



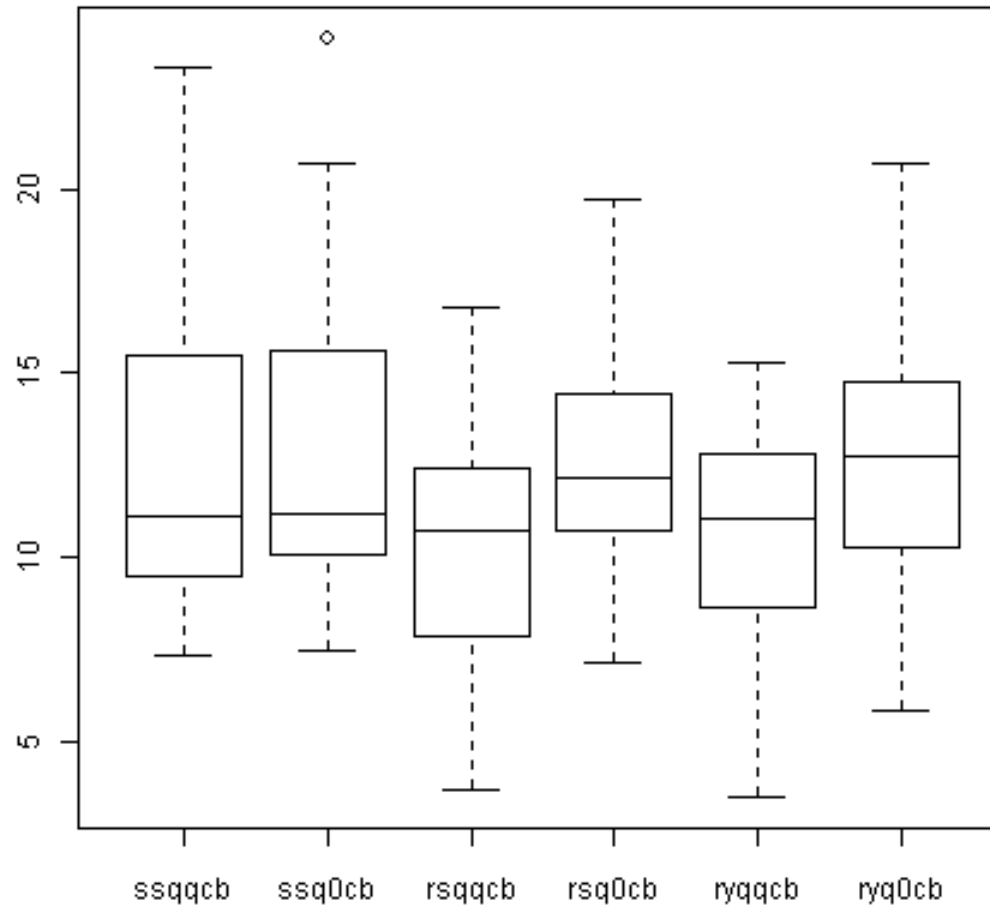
# Median Lifetime Displacements

	<b>With Fishing</b>	<b>Without Fishing</b>
SSAP Skipjack	419 (28)	424
RTTP Skipjack	411 (158)	471
RTTP Yellowfin	337 (132)	380

# Exclusive Economic Zones



# EEZ Halflife



# Coconut Hole Halflife

Coconut Hole	Halflife
I 61	9
I 62	11
I 63	15

# Conclusions (1)

- Median lifetime displacements for yellowfin and skipjack exceed 200 Nmi
  - Certainly “straddling” if not “highly migratory”
  - International cooperation between neighbors will help achieve management goals
  - Biological definition of “highly migratory”?

## Conclusions (2)

- Yellowfin and skipjack populations reside for substantial periods within EEZs and high-seas enclaves
- Residence time in coconut holes is comparable to residence time in EEZs