



**REVERSING ENVIRONMENTAL DEGRADATION TRENDS  
IN THE SOUTH CHINA SEA AND GULF OF THAILAND  
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# **Use of Ichthyoplankton Survey in Fisheries Resource Management**

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Regional Technical Working Group  
(Fisheries)



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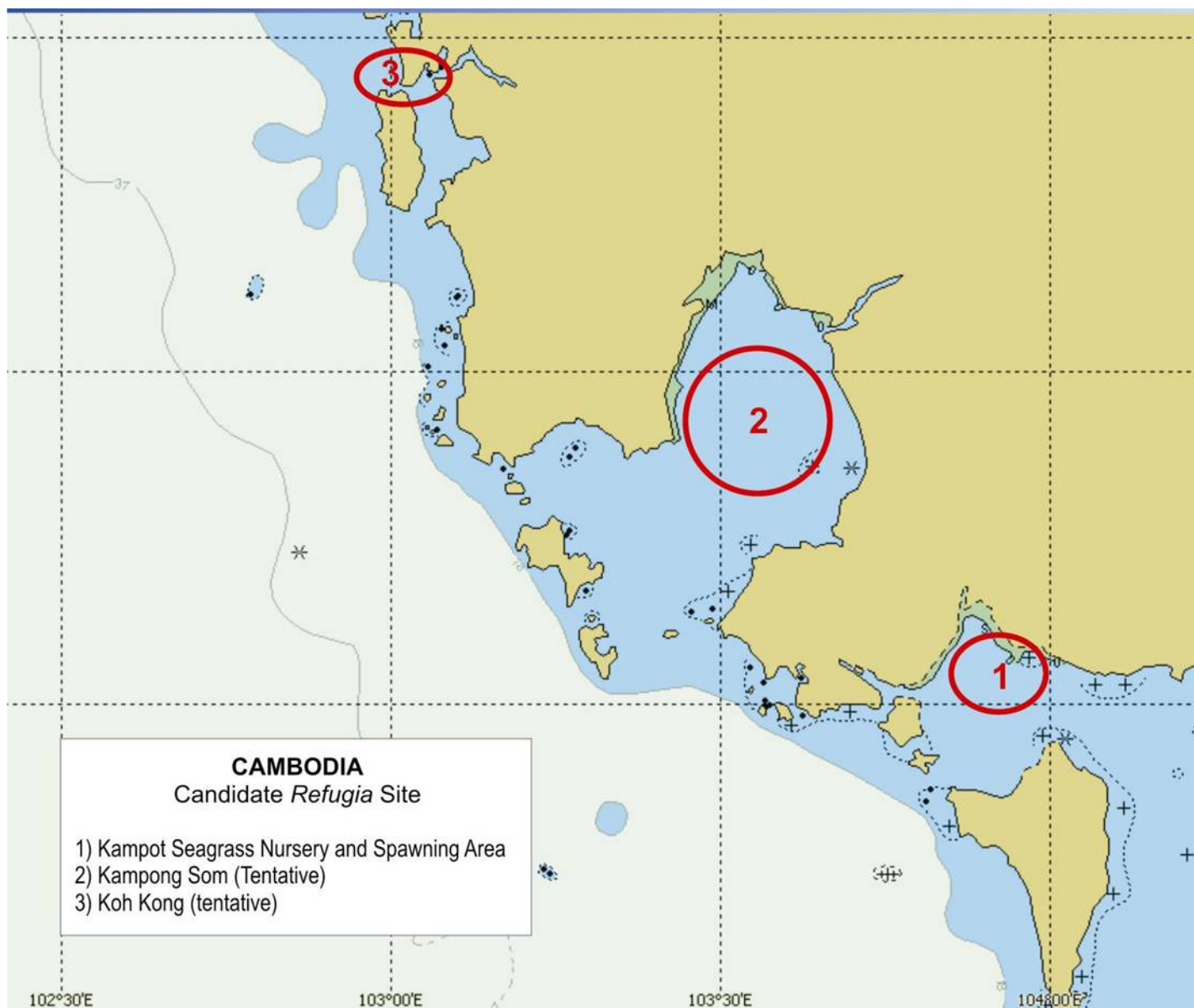
## **Presentation Outline**

- **Establishment of fish *refugia***
- **Recruitment**
- **Ichthyoplankton survey**
- **Some practical applications**



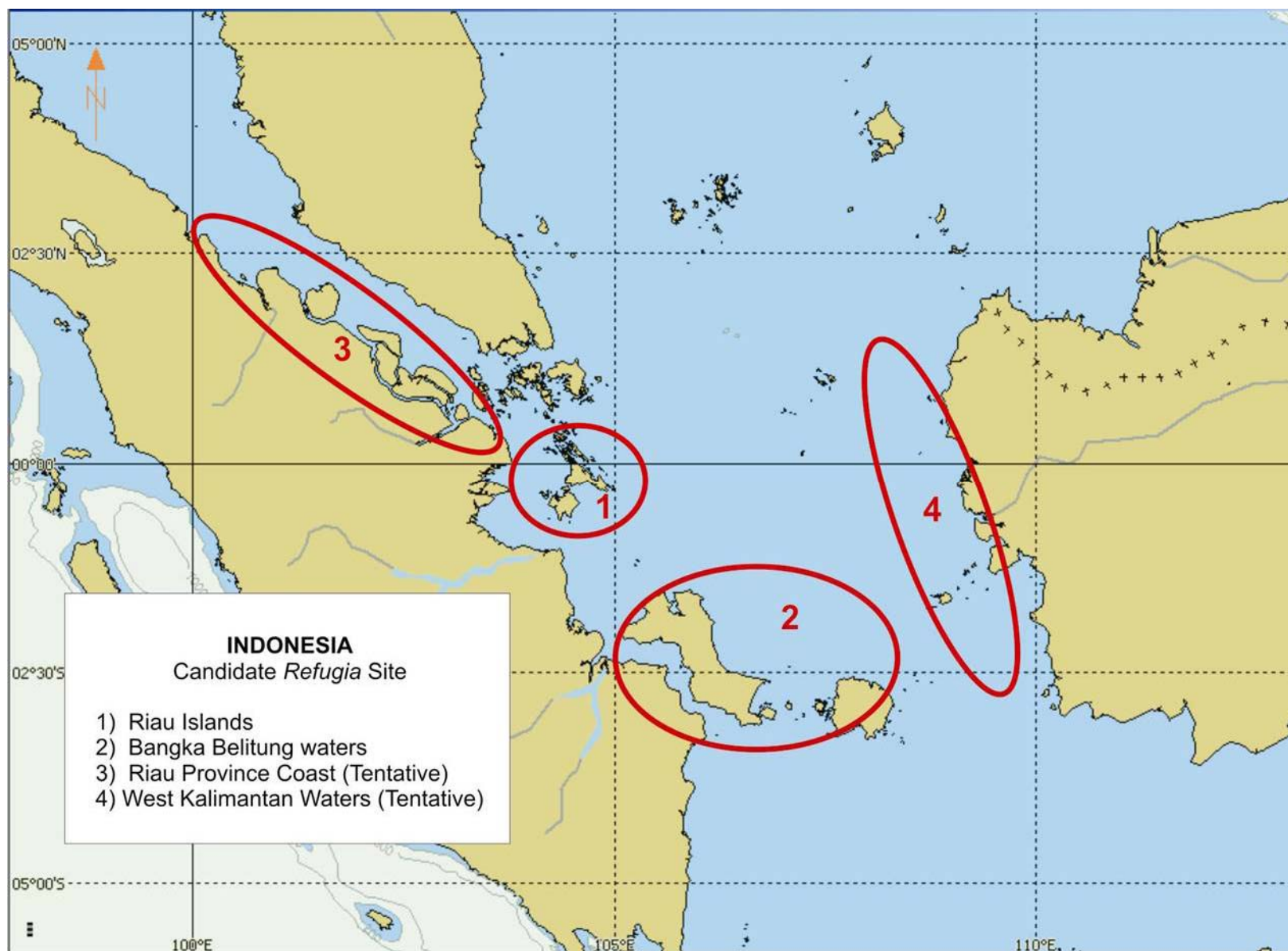
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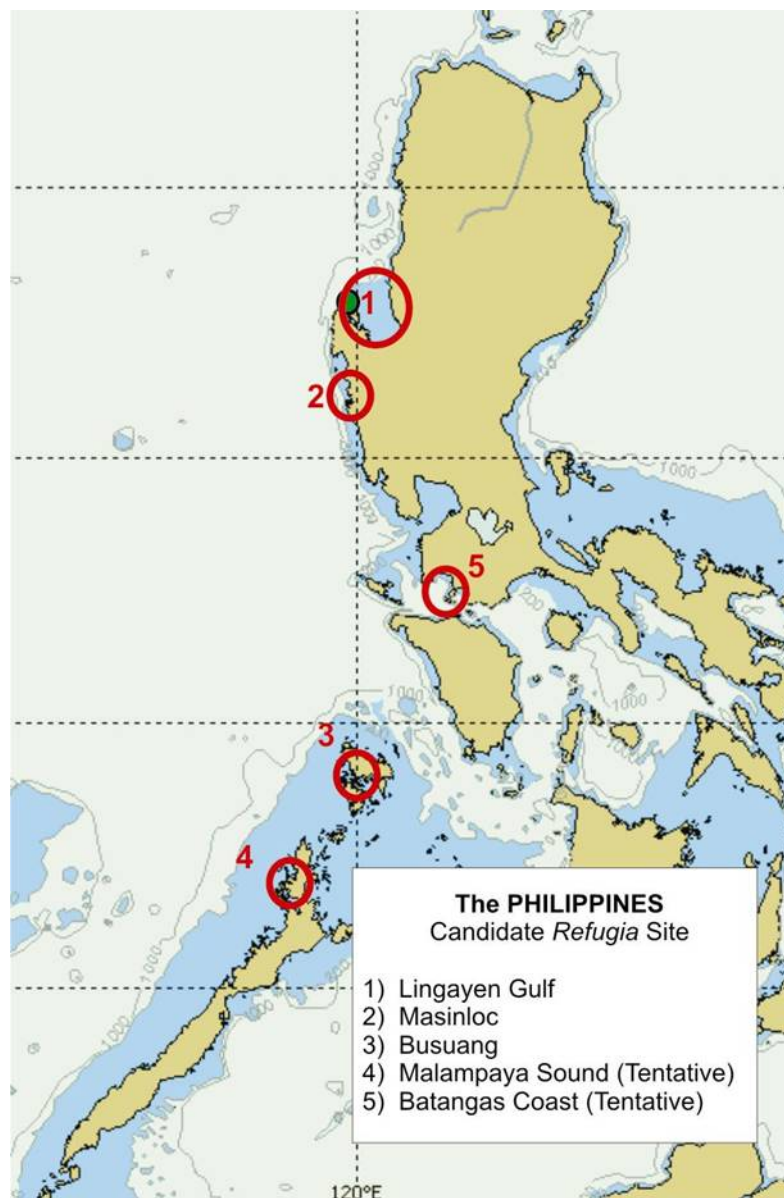
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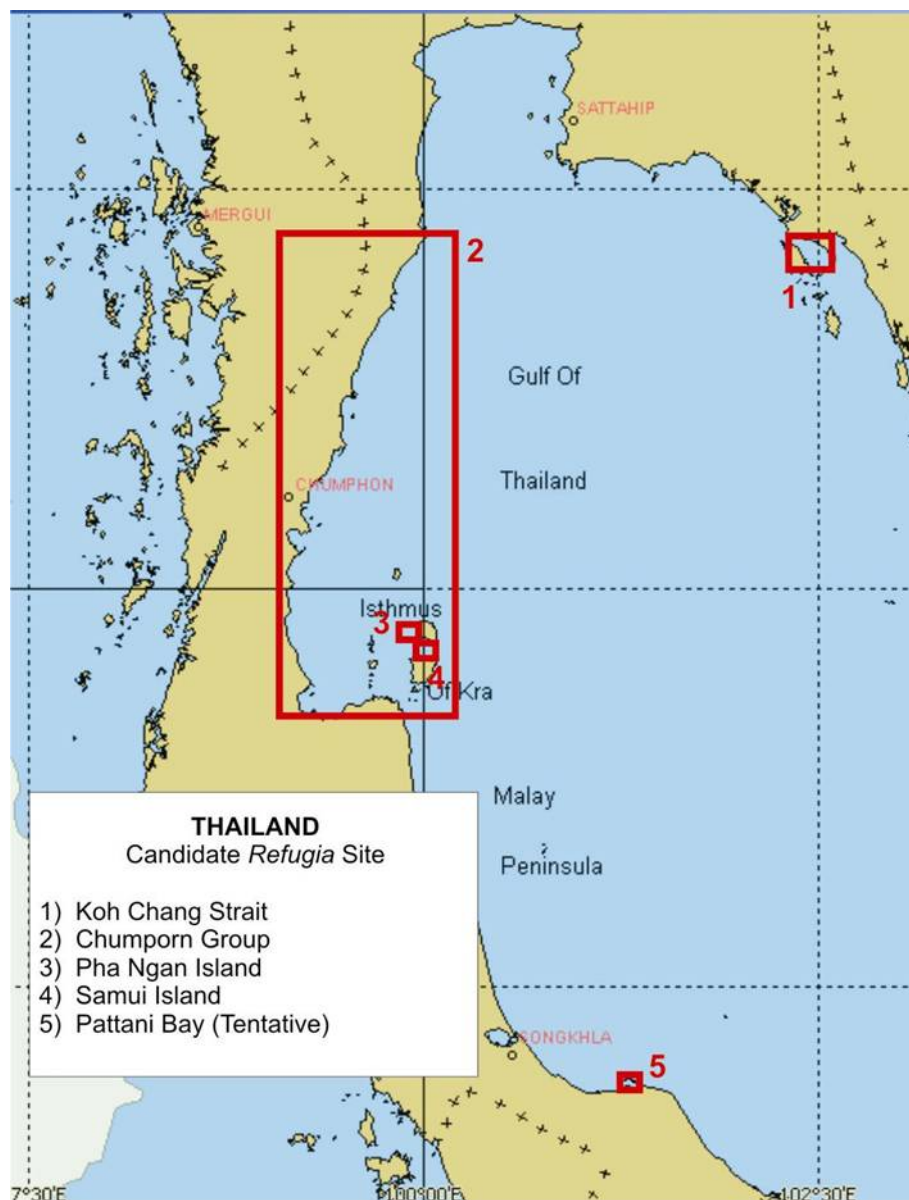
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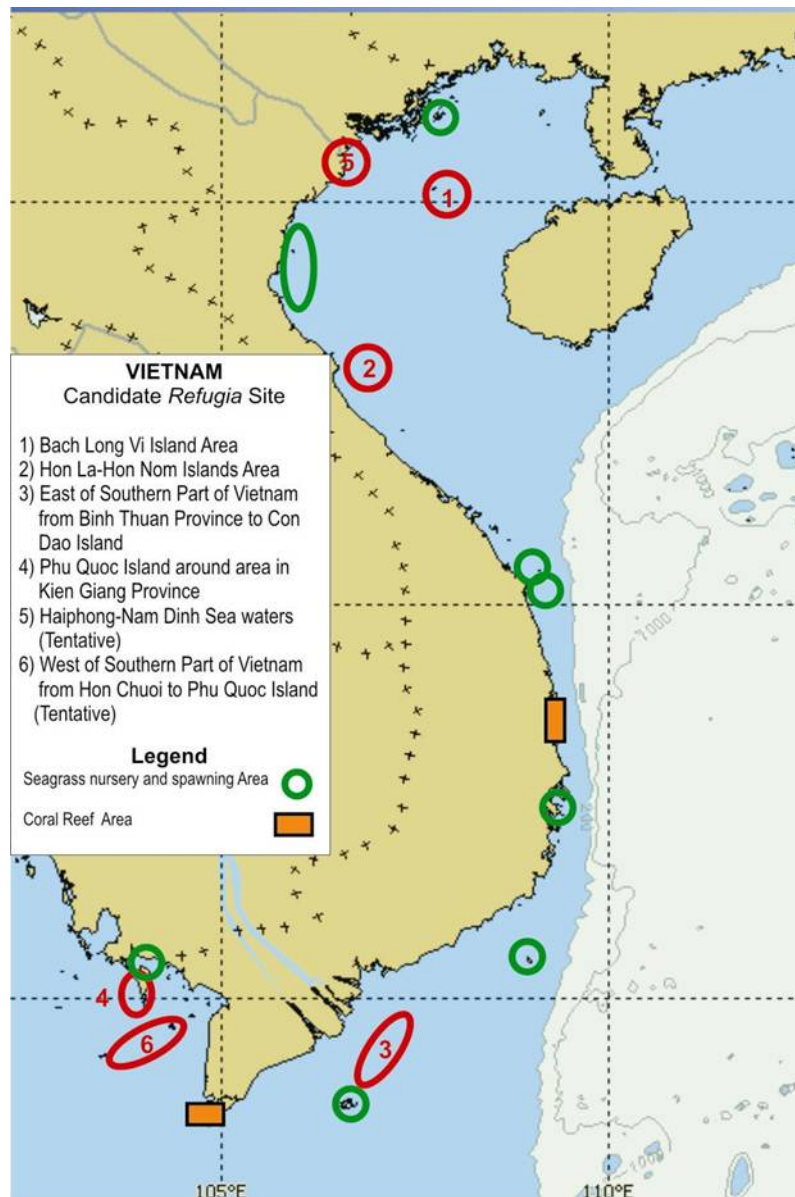
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Fisheries Management Intervention

## Establishment of “Fish *Refugia*”

Protecting specific life stage/s of a fish stock

Enhance Recruitment

Sustainable Fisheries

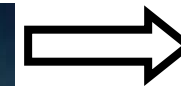


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## Russel's axiom

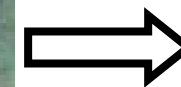
(Russel 1931)

Growth 



Natural  
Death

Recruitment 



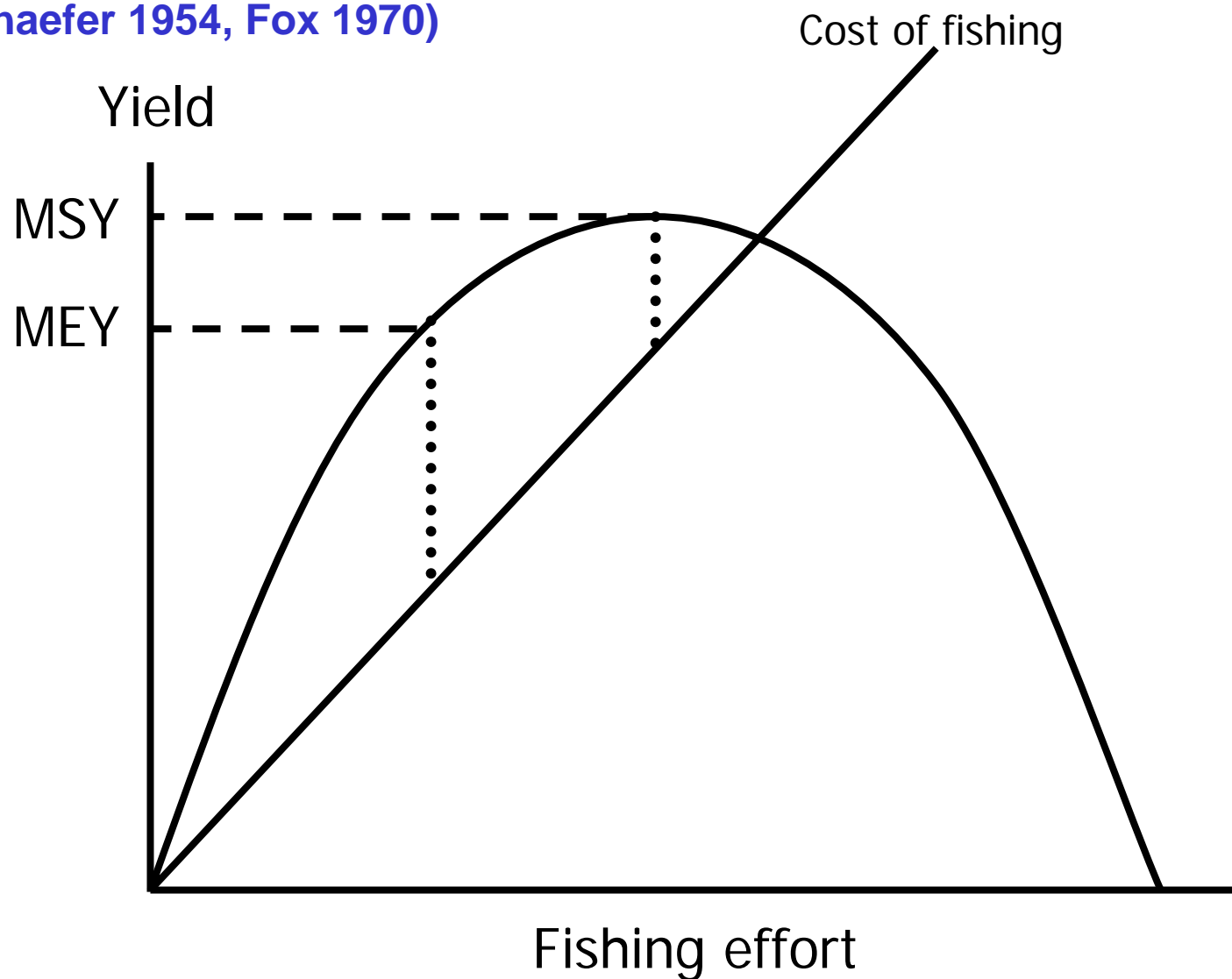
Fishing



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## Surplus production

(Schaefer 1954, Fox 1970)



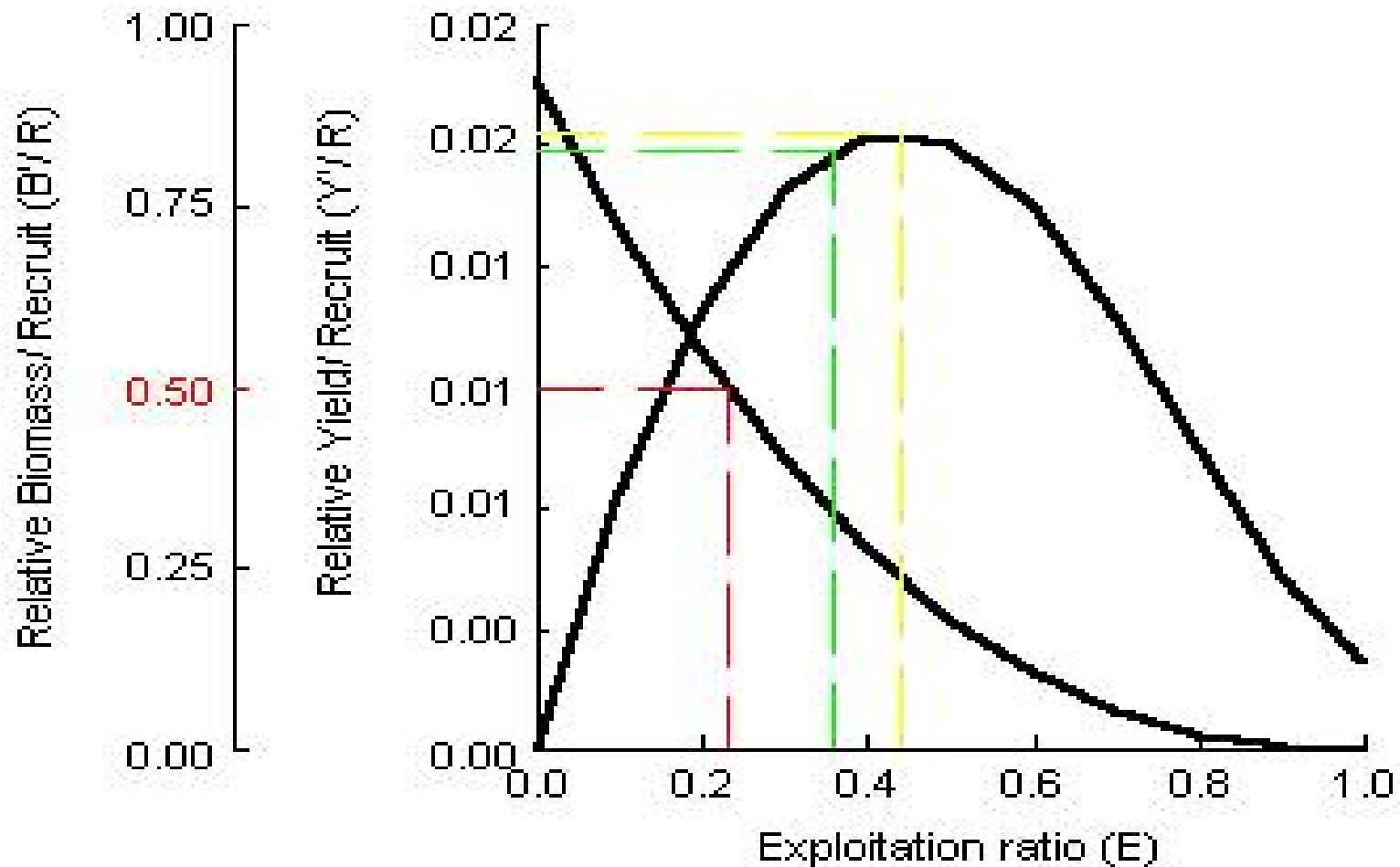


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## Yield per recruit analysis

(Beverton and Holt 1957)

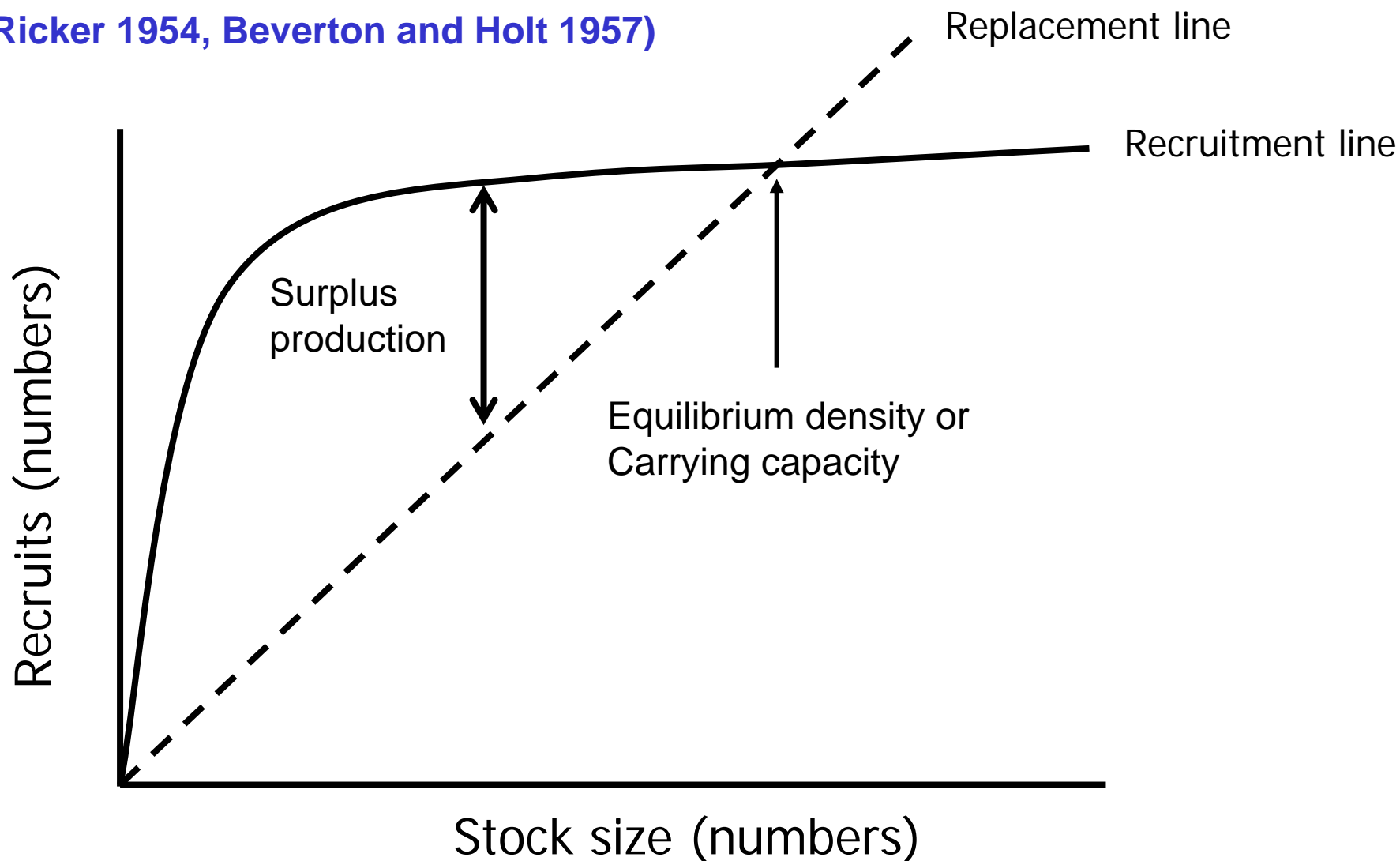




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## Stock-Recruitment curve

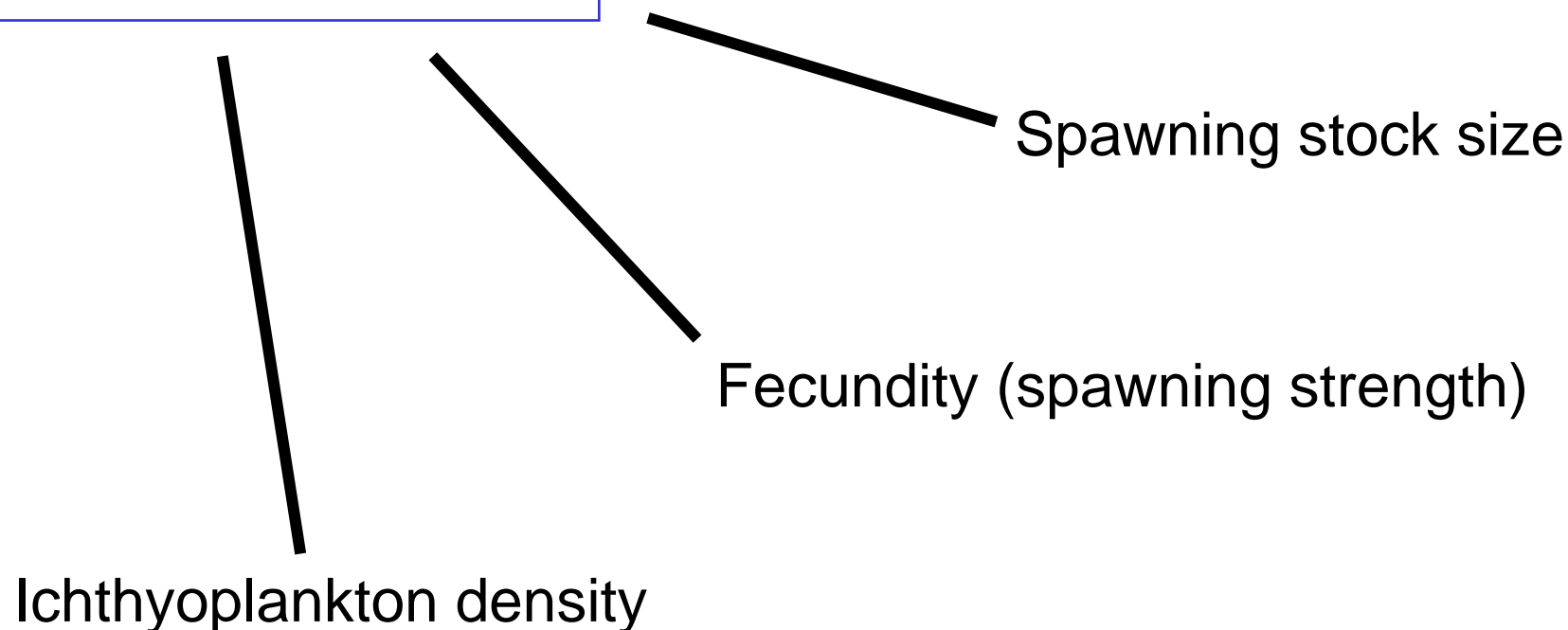
(Ricker 1954, Beverton and Holt 1957)





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# Recruitment





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## **Ichthyoplankton survey**

**Provides information on potential recruits:**

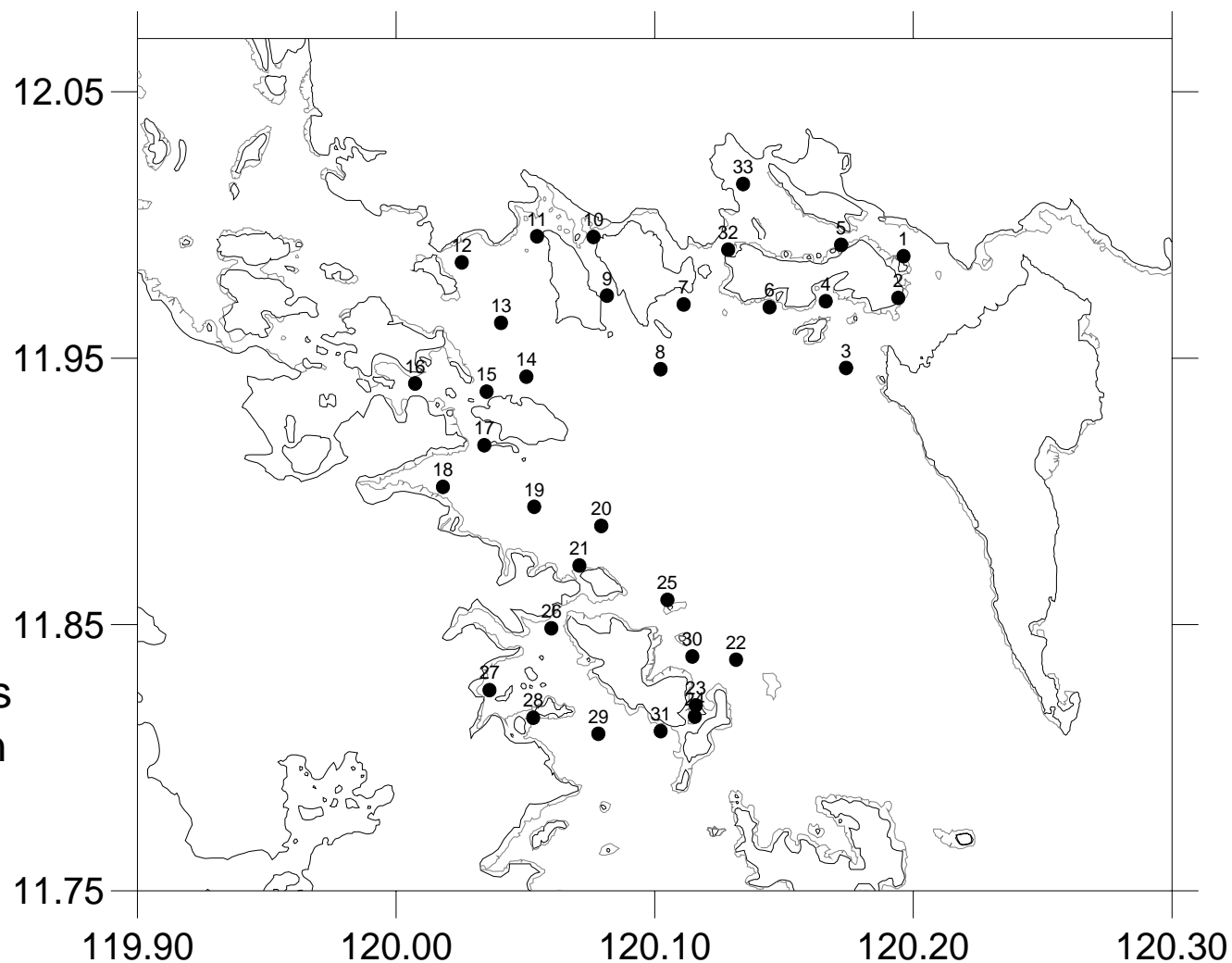
- What species of fish?**
- Where they are found?**
- How many (density)?**
- Seasonal fluctuations?**



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**Plankton  
stations**

Map of plankton stations  
in Calamianes, Palawan  
in May 2004 (Campos  
2004)

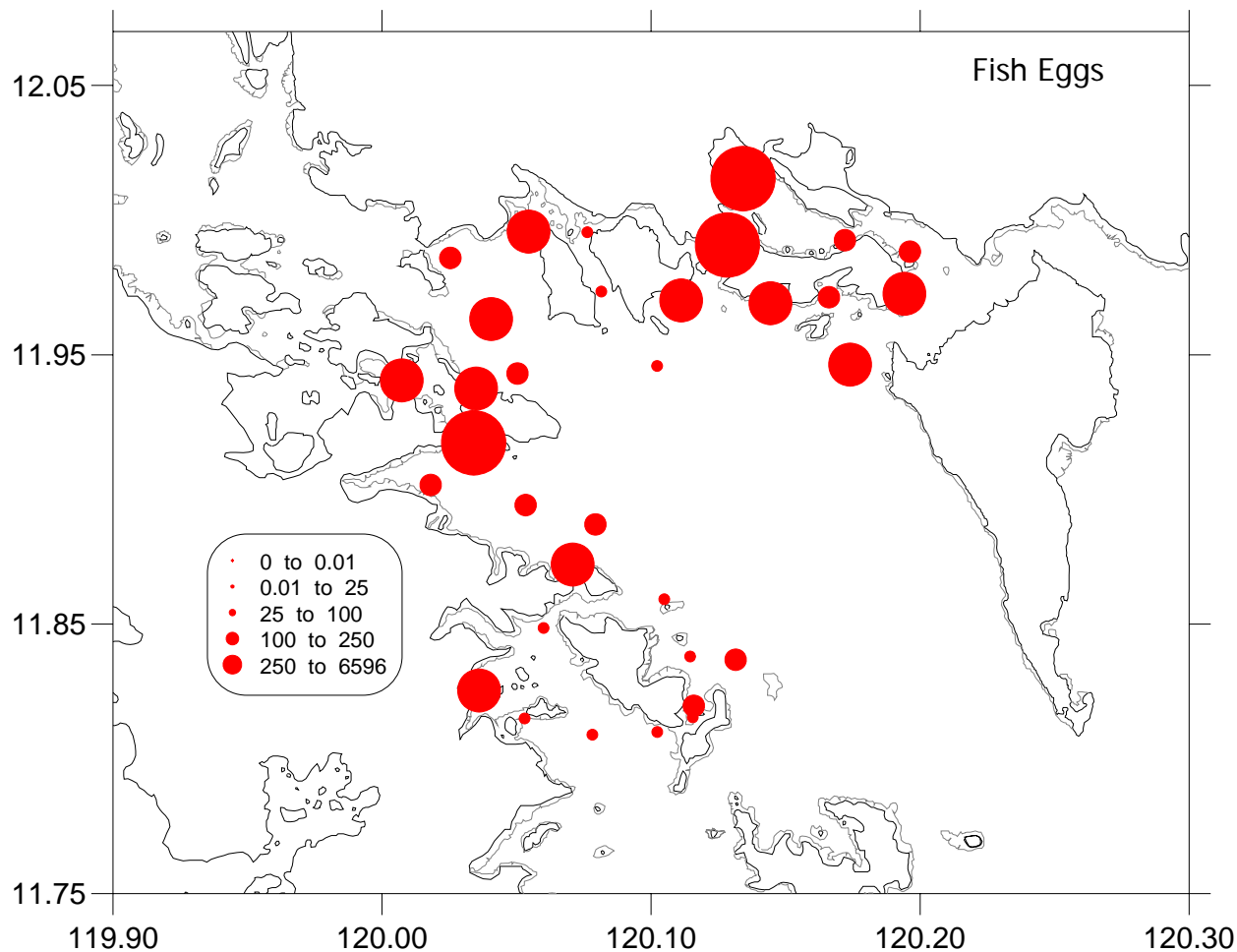




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**Fish eggs  
distribution**

Density (no./100m<sup>3</sup>)  
distribution of fish eggs  
in Coron Bay in April  
2004 (Campos 2004)

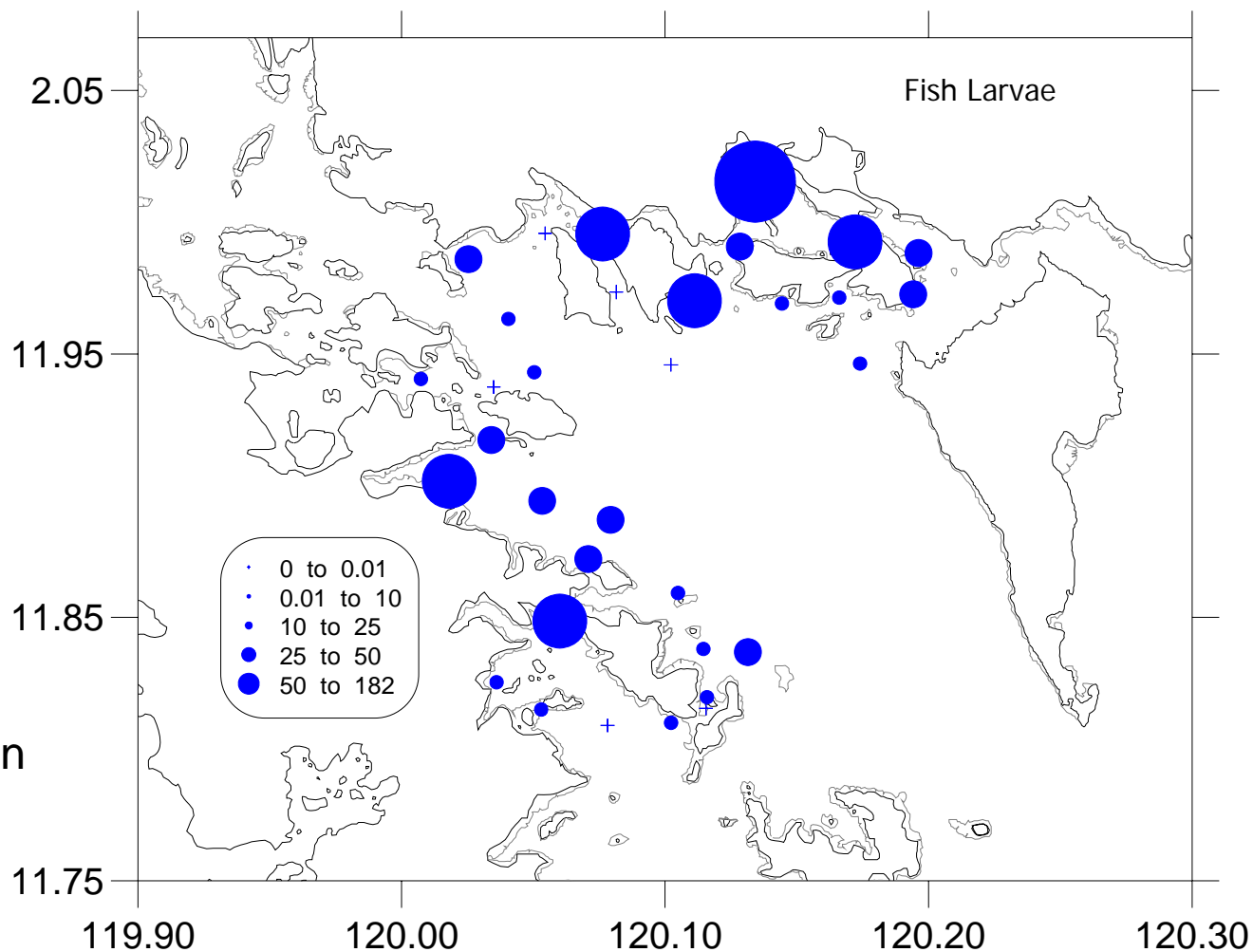




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**Fish larvae  
distribution**

Density (ind./100m<sup>3</sup>)  
distribution of fish  
larvae in Coron Bay in  
April 2004. (Campos  
2004)

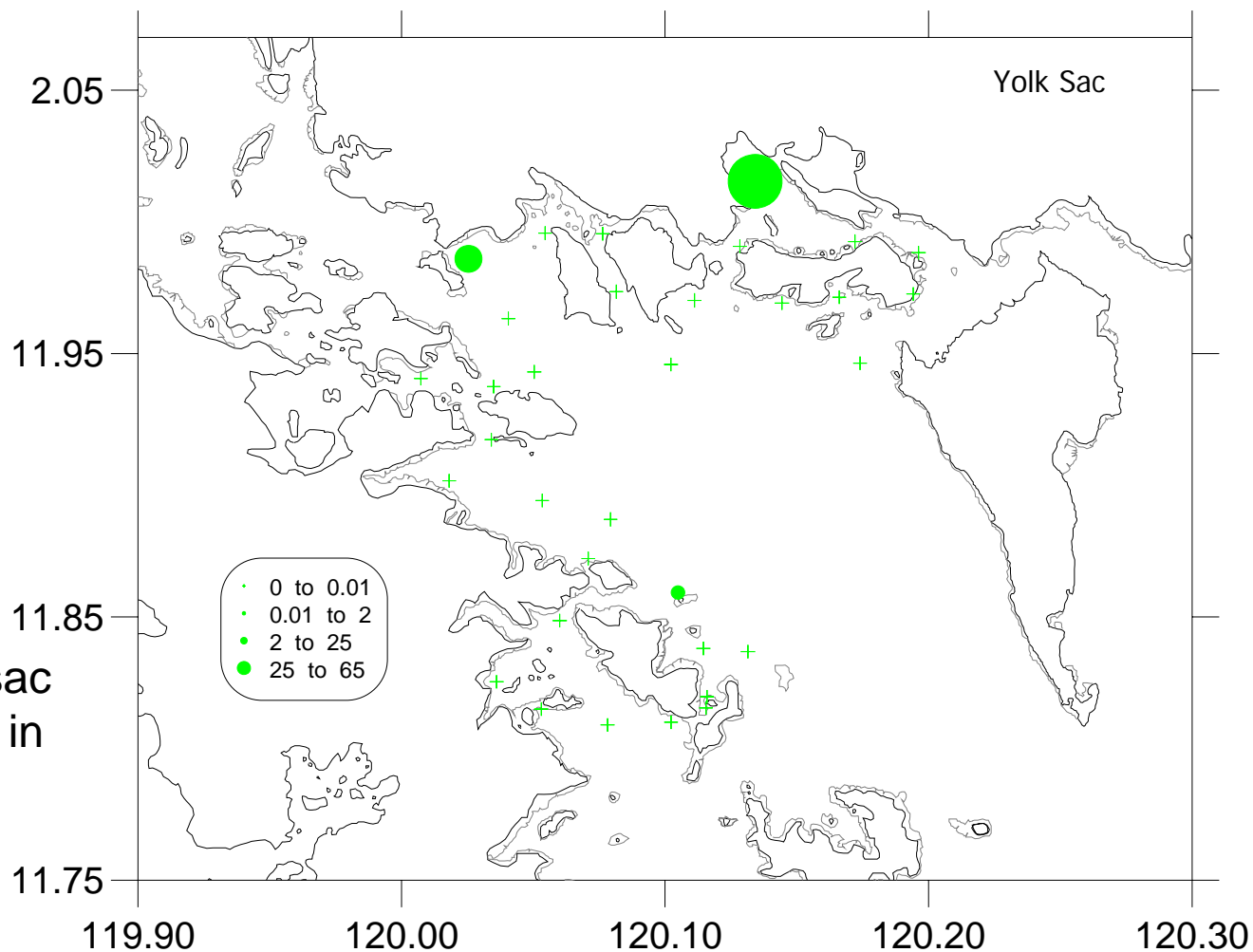




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**Yolk sac larvae  
distribution**

Distribution of yolk sac  
larvae in Coron Bay in  
April 2004 (Campos  
2004)





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**Fish larvae  
composition**

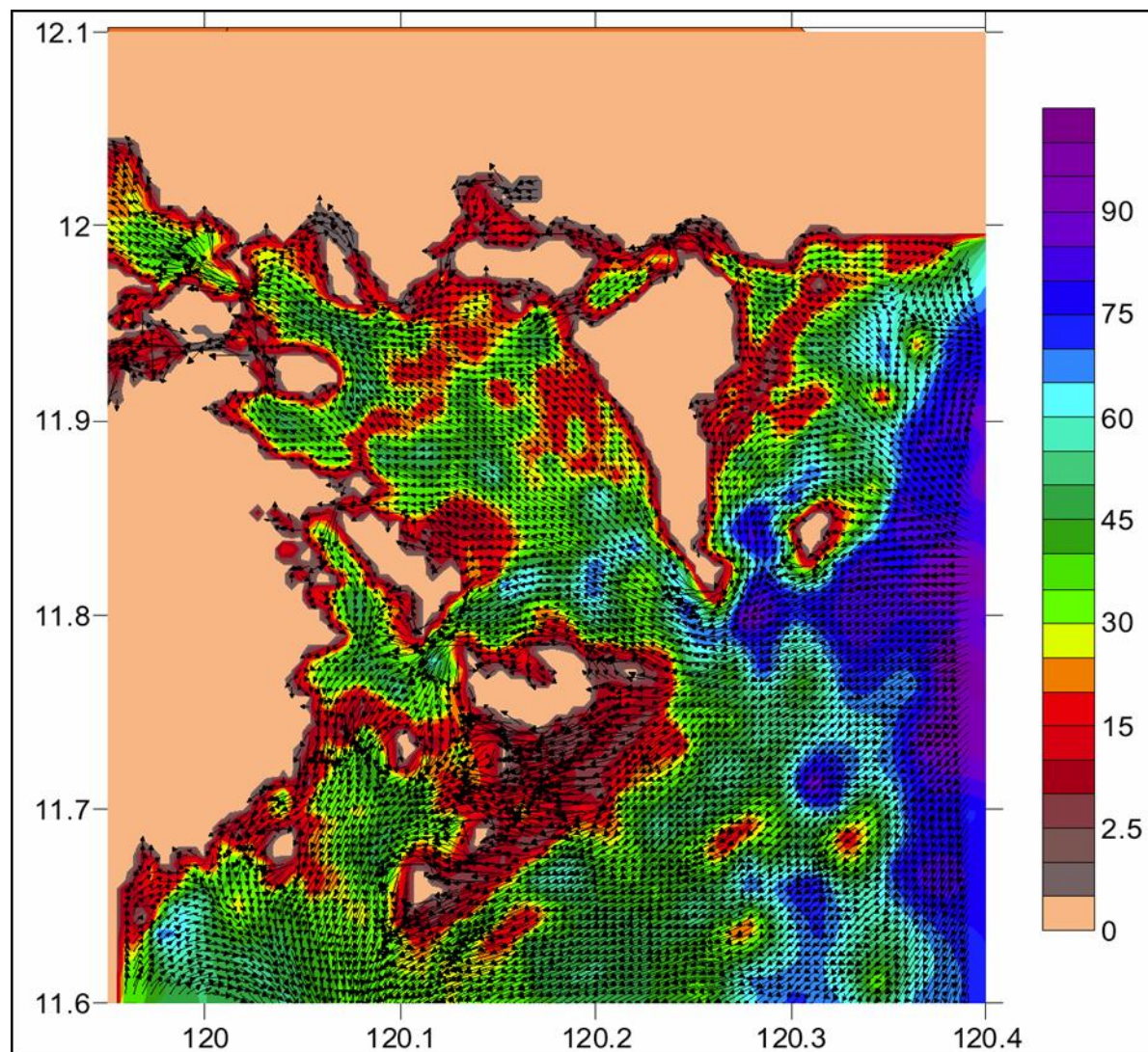
Larvae Families	Larval Density (ind/100m <sup>3</sup> )	Standard deviation	Relative Abundance (%)
Gobiidae	4.99	12.68	29.4
Mullidae	2.58	5.39	15.2
Pomacentridae	1.33	3.98	7.8
Scombridae	1.07	1.78	6.3
Atherinidae	0.98	3.23	5.8
Terapontidae	0.87	2.61	5.1
Blenniidae	0.63	1.54	3.7
Monacanthidae	0.41	1.64	2.4
Cynoglossidae	0.35	2.04	2.1
Sphyraenidae	0.21	0.73	1.2
Labridae	0.20	0.85	1.2
Clupeidae	0.13	0.58	0.8
Callionymidae	0.13	0.41	0.7
Sillaginidae	0.12	0.72	0.7
Apogonidae	0.06	0.37	0.4
Lethrinidae	0.06	0.37	0.4
Engraulidae	0.05	0.27	0.3
Carangidae	0.05	0.27	0.3
Trichiuridae	0.05	0.27	0.3
Gerreidae	0.04	0.24	0.24
Polynemidae	0.04	0.24	0.24
Priacanthidae	0.04	0.20	0.21



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**Circulation  
pattern**

General tidal  
circulation in Coron  
Bay (Villanoy 2006).

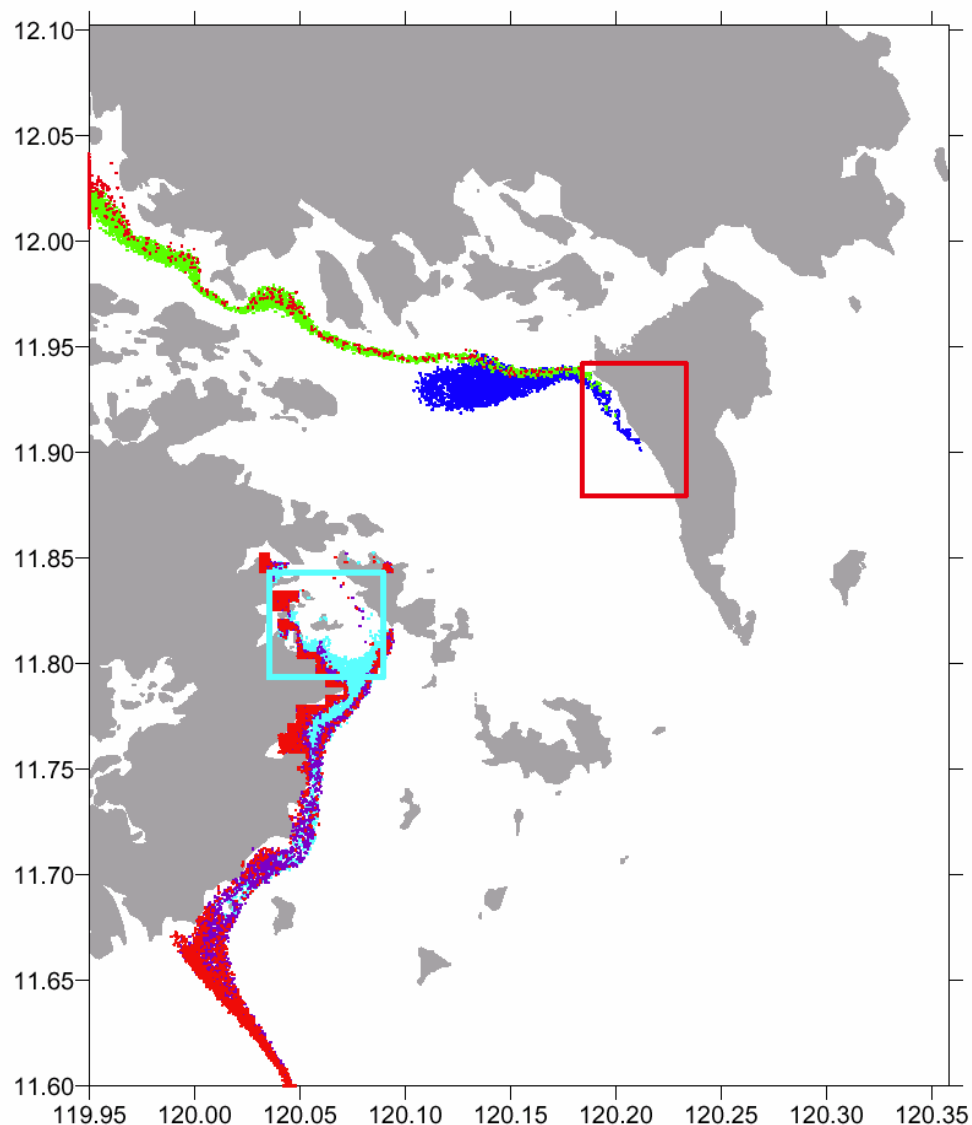




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**Dispersal  
simulation**

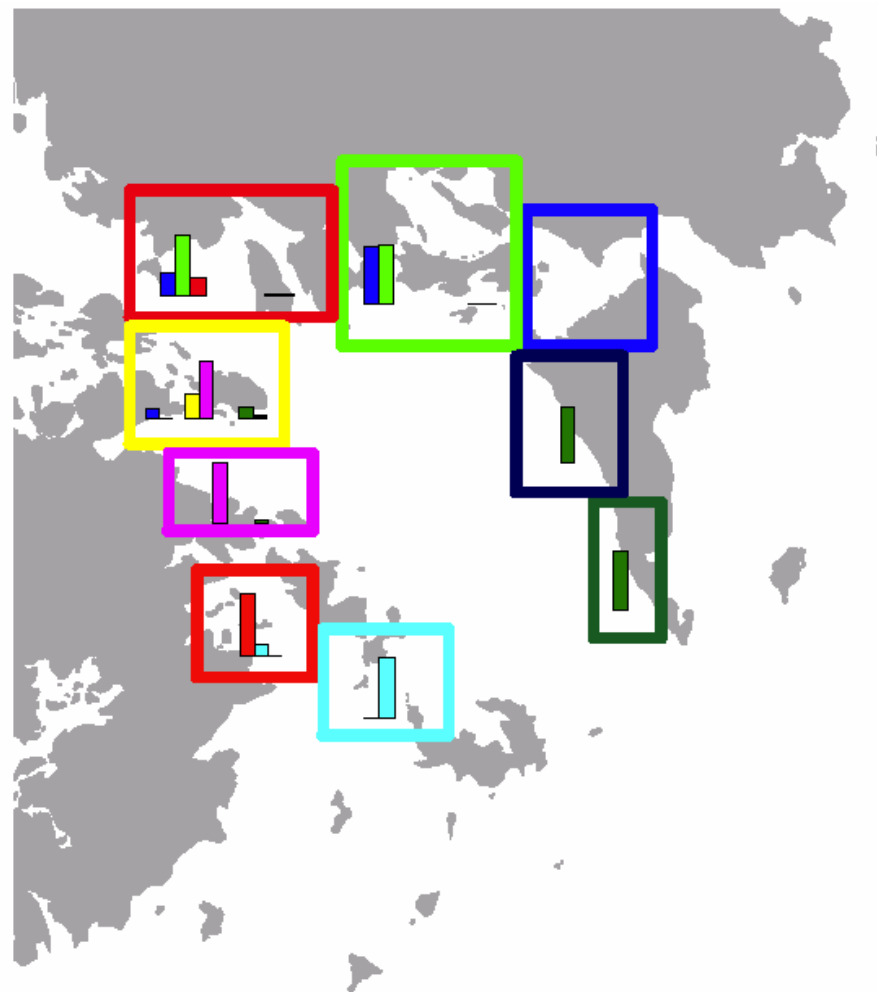
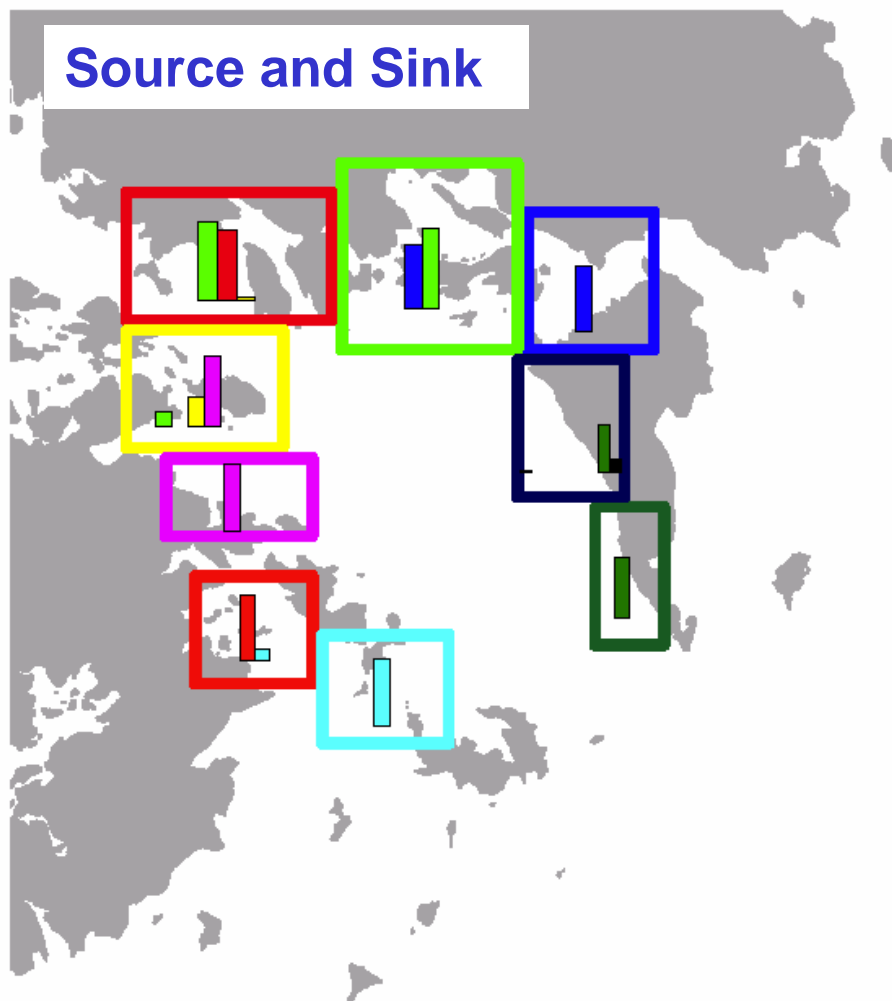
Simulation of  
dispersal in Coron  
Bay (Villanoy 2006).





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Source and Sink



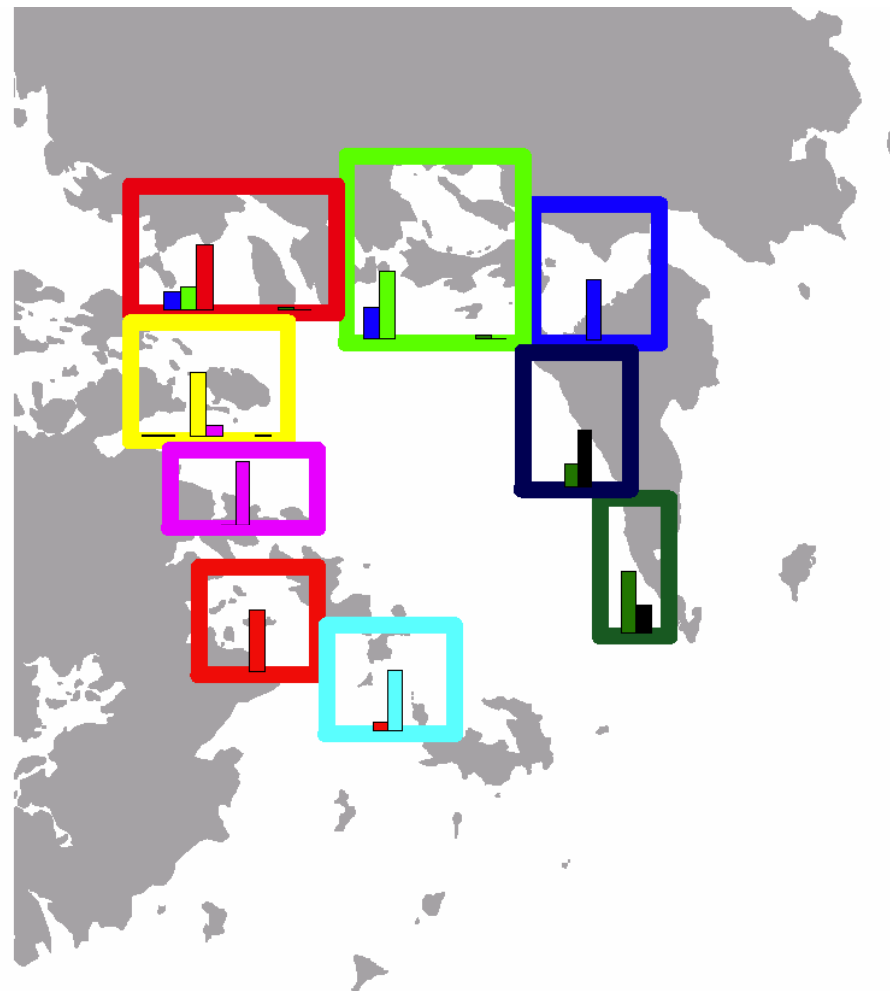
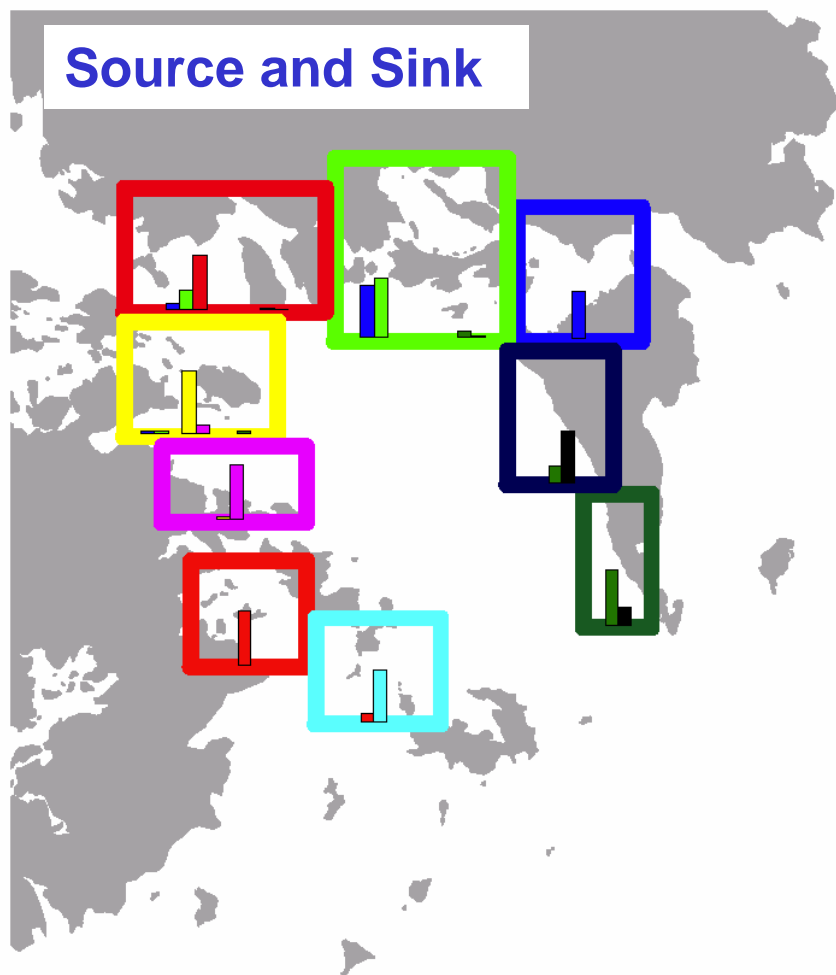
**April Dispersal**

Source areas and relative amounts of dispersed particles settling in each of the areas marked by the colored boxes. Colored bars within each box represent the sources of the particles that settled in a particular box. L= 20 days, R=30 days. (Villanoy, 2006)



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### Source and Sink



### **January Dispersal**

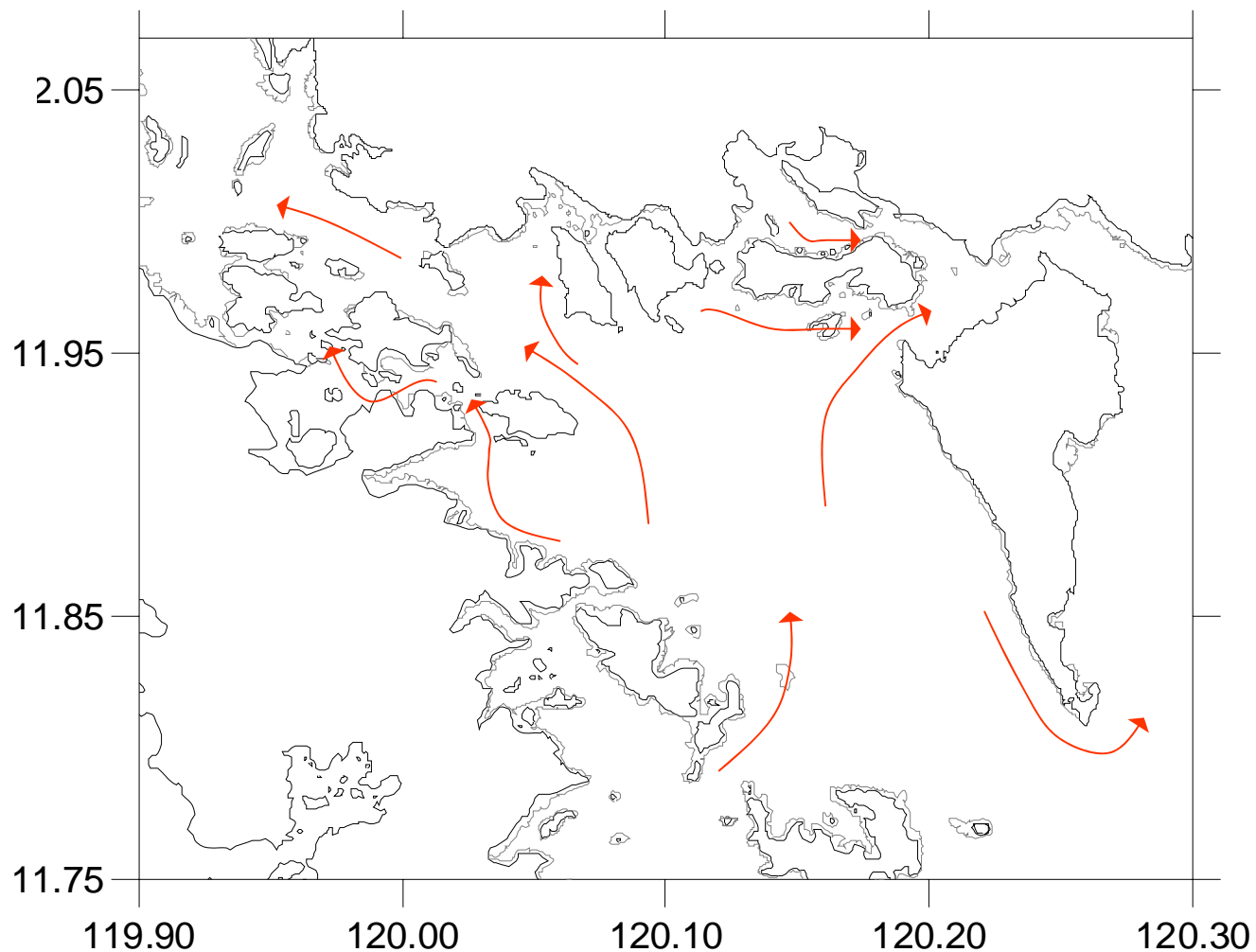
*Sink areas and relative amounts of particles dispersed from each of the areas marked by the colored boxes. Colored bars within each box represent where the particles released from a source box ended up. L=20 days, R=30 days.*



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**Simulated  
dispersal**

Simulated dispersal  
resulting from tidal  
circulation in Coron  
Bay (Villanoy 2006).



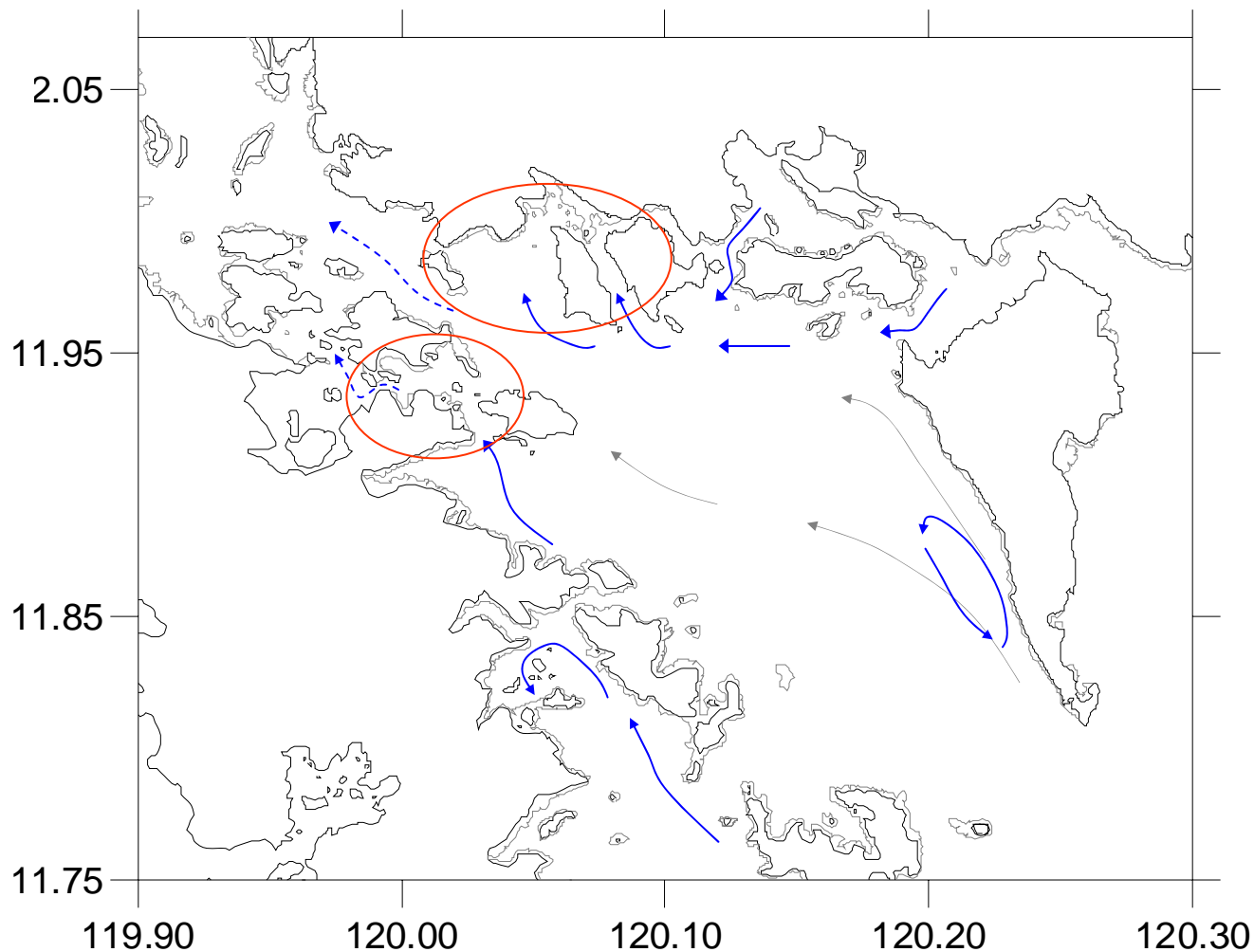


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### Simulated dispersal

Simulated  
dispersal with  
wind effects  
typical of April  
(Villanoy 2006).

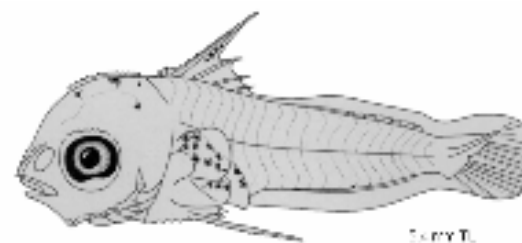
Red ellipses indicate areas  
where settled particles  
originate from several  
sources. Grey lines  
indicate possible but weak  
dispersal, apparent only  
after 30 days.



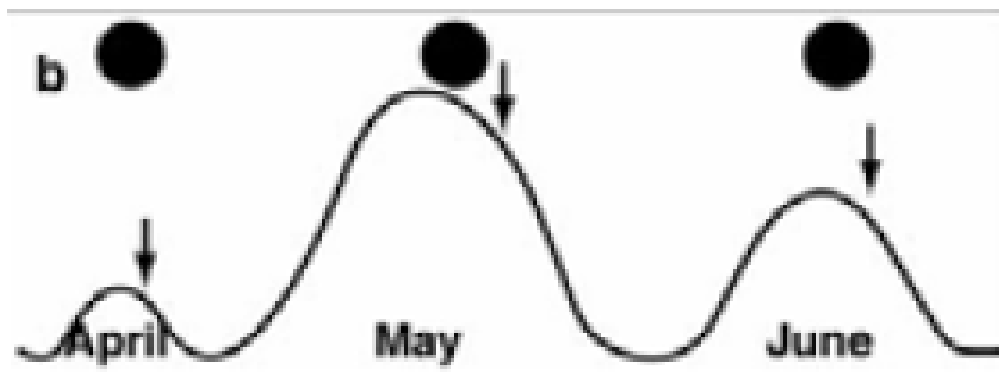


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Observing closed season for rabbit fish, *Siganus canaliculatus*



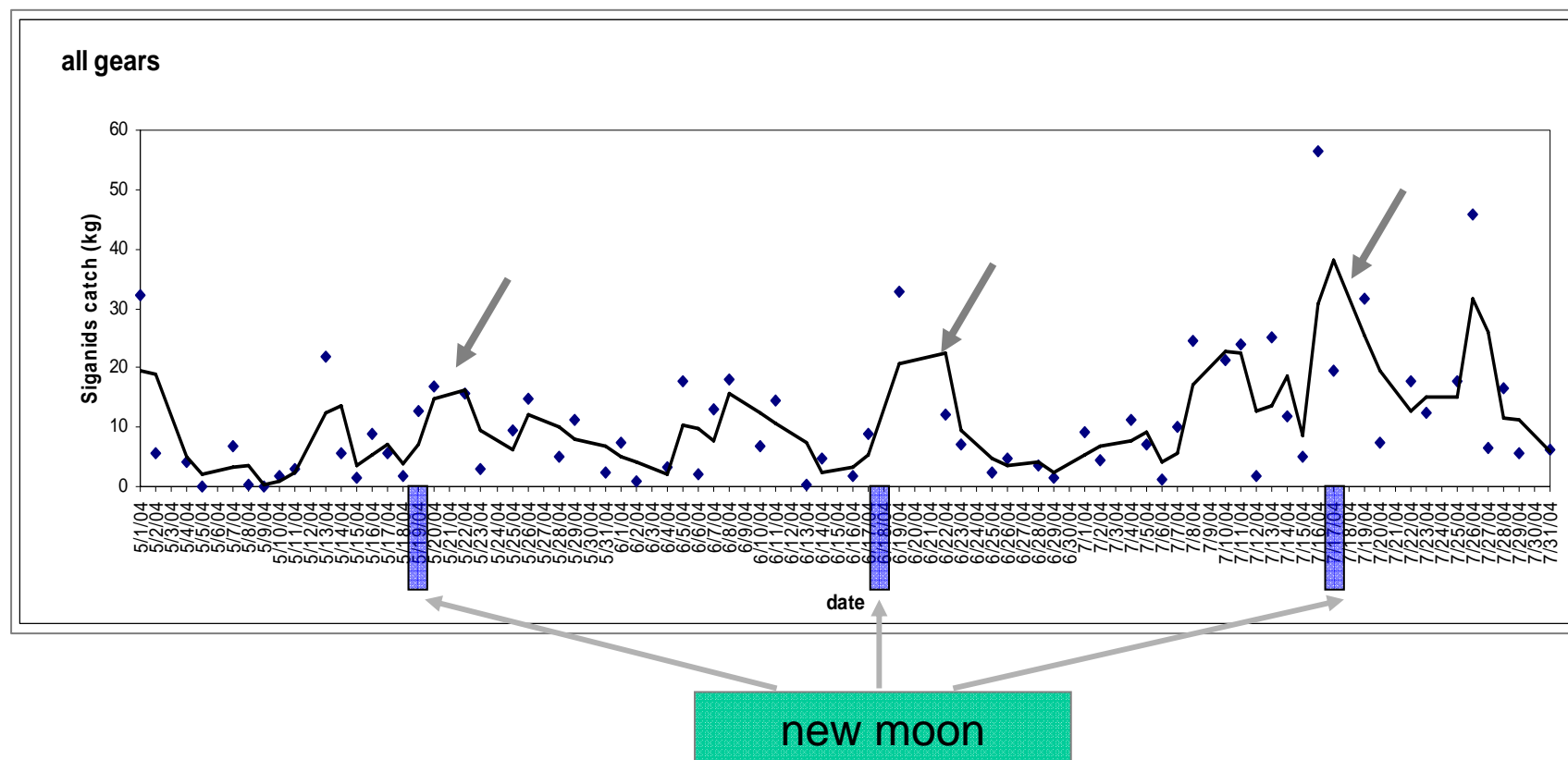
*S. fuscescens* (Source: American Society of Ichthyologists and Herpetologists)





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Observing closed season for rabbit fish, *Siganus canaliculatus*



Catch monitoring data from various gears catching rabbit fish in  
Danajon Bank from May to July 2004

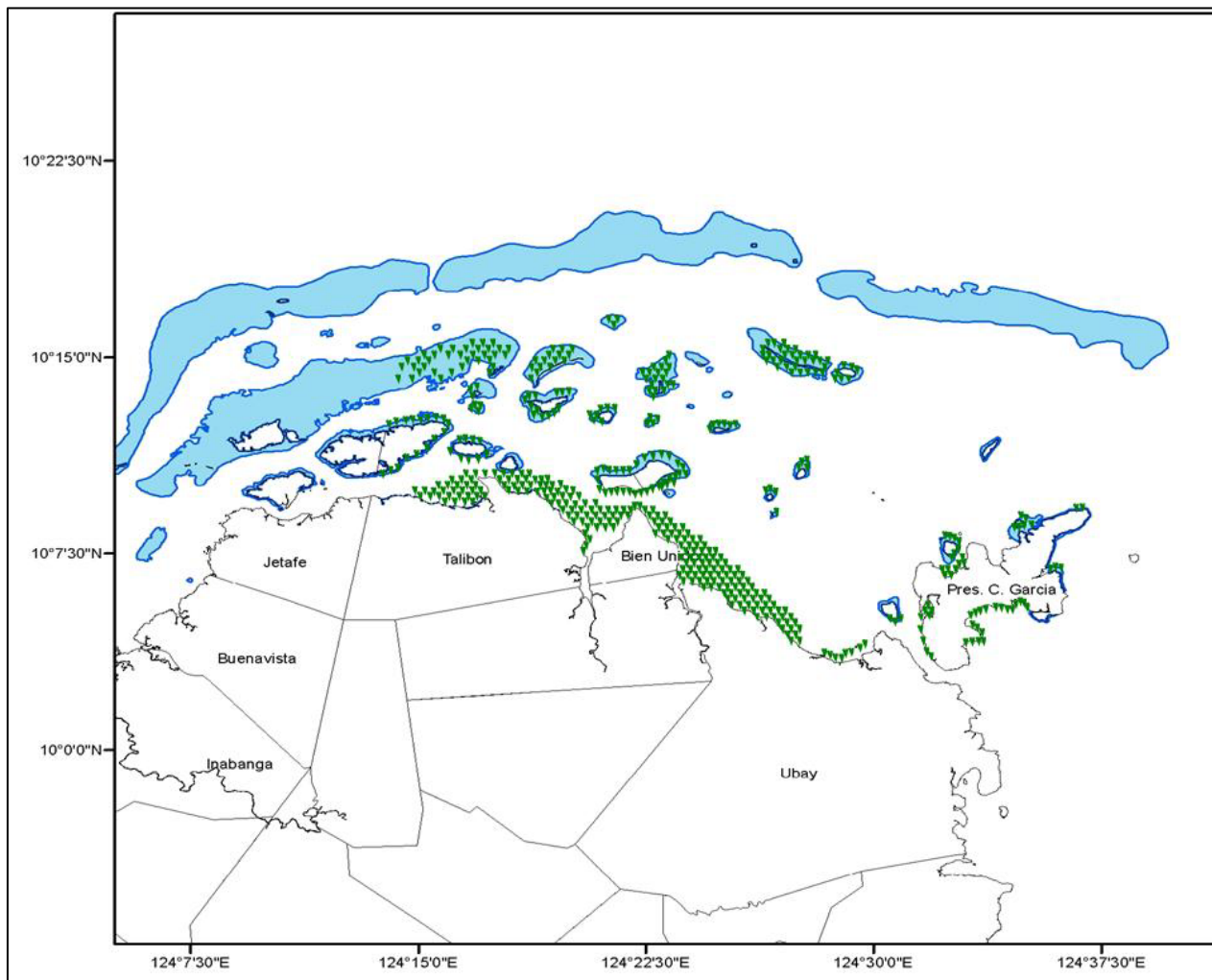


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**Major seagrass areas**

**Closed Season:**

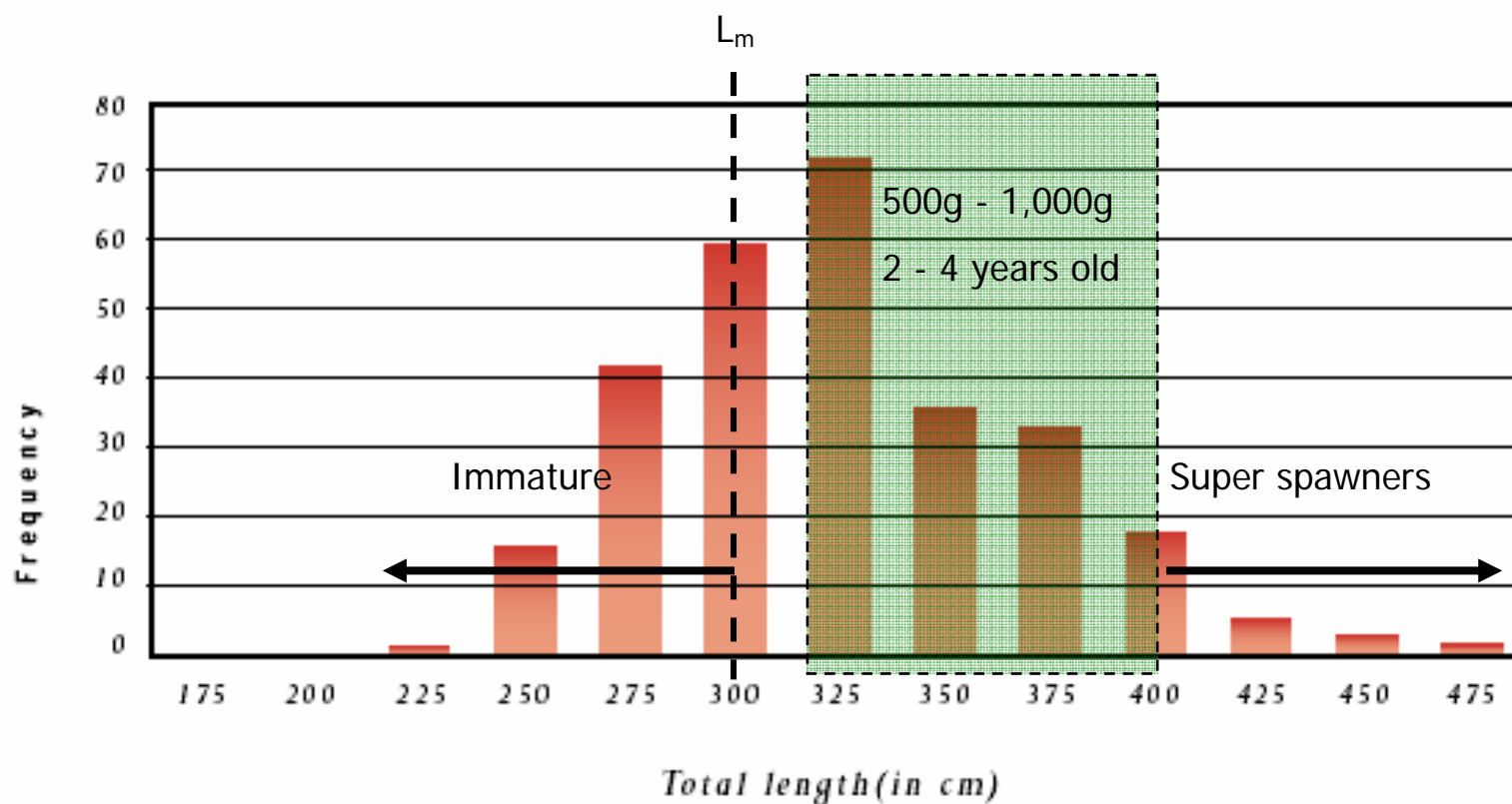
- In seagrass areas
- 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> nights after the new moon
- March, April & May





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Closed season for red grouper, *Plectropomus leopardus*

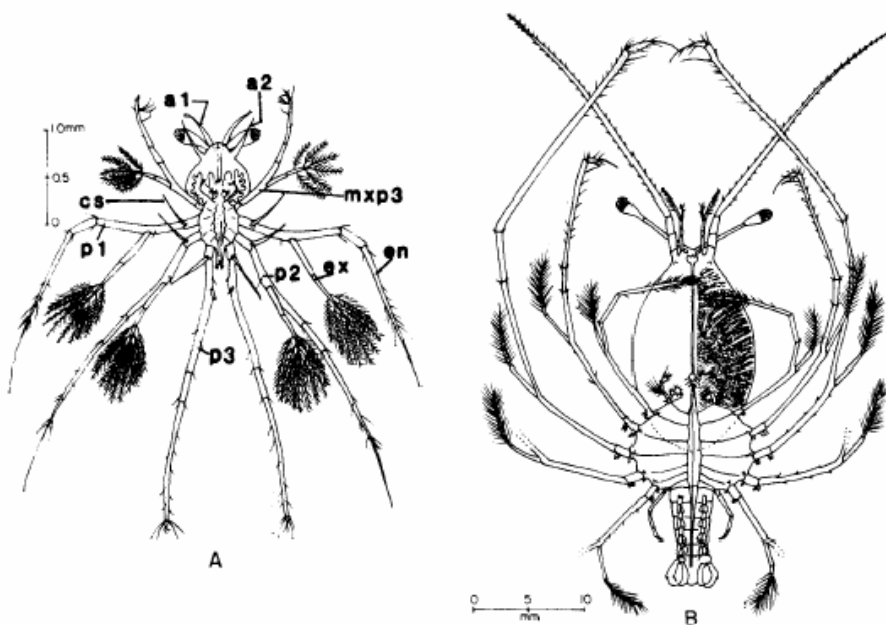


Length frequency distribution of *Plectropomus leopardus* in  
Calamianes in 1998 (Mamauag *et al.* 2002)



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**Ban on harvest of berried lobster**



Panulirus larva, (A) Stage I and (B) Stage IX





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## Alternative sampling gears

- Beach seine
- Push net
- Fry gathering net



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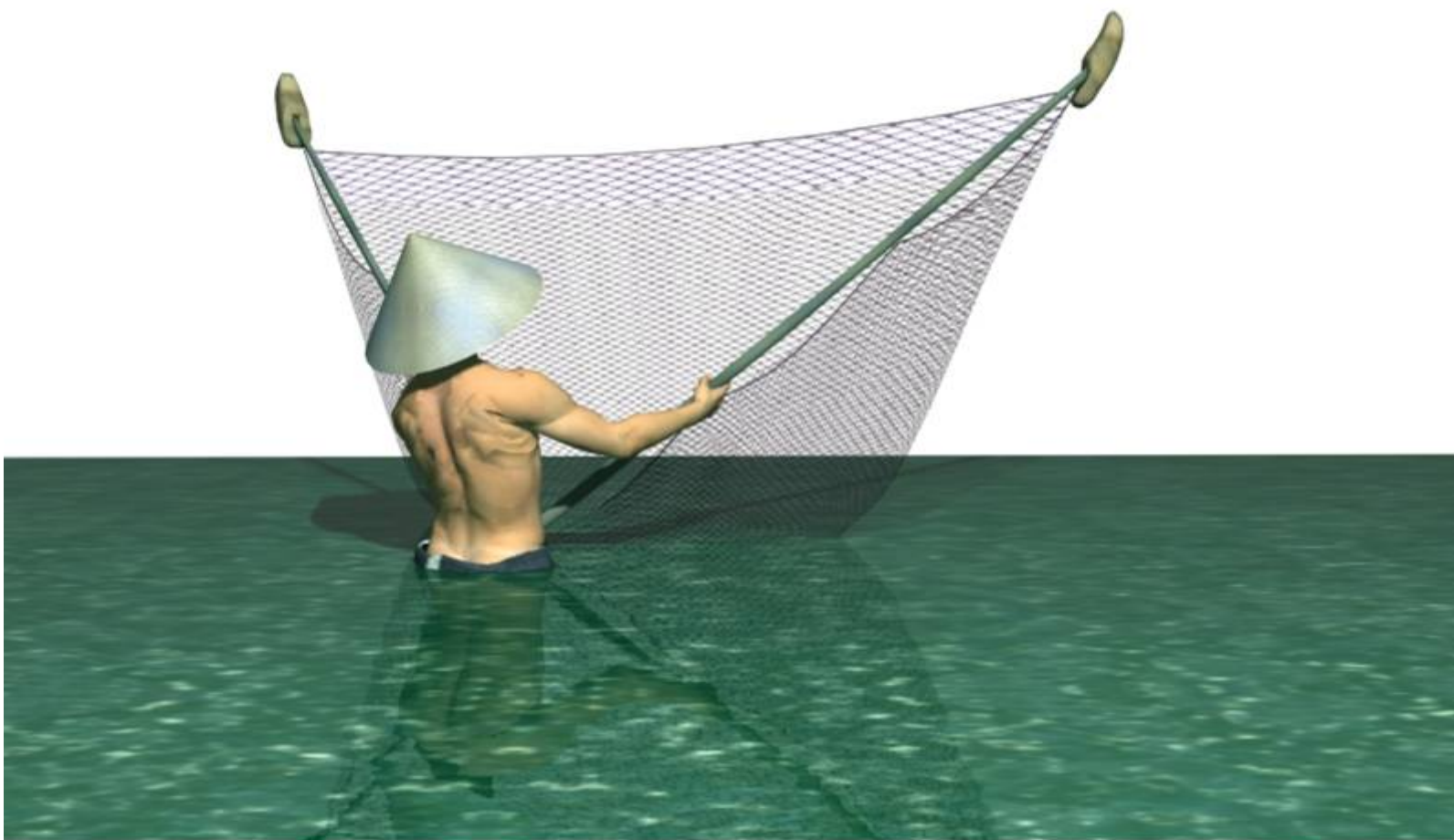
**Beach seine**





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**Push net**





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**Fry net**







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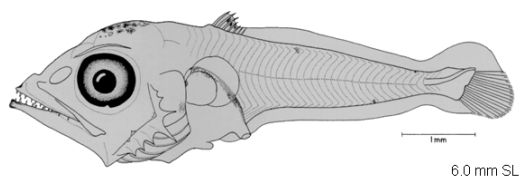
**Catch of push net**



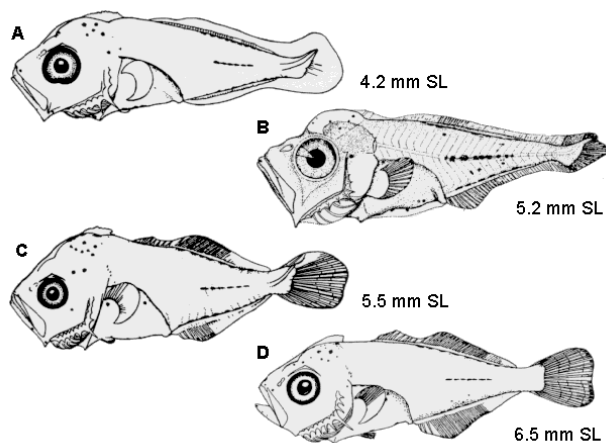


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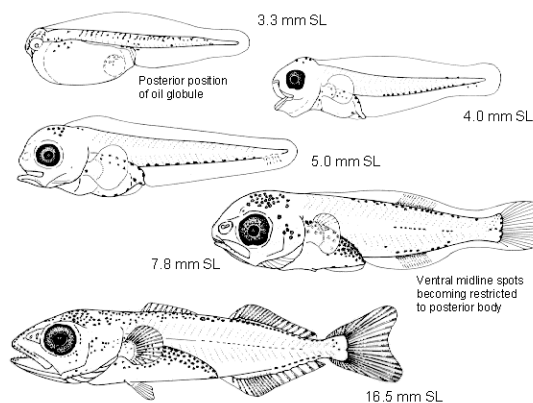
## Species of interest



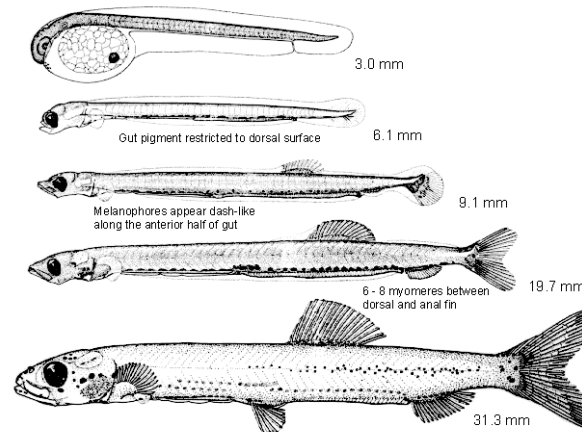
**Tuna**



**Carangids**



**Scombrids**



**Sardines**