

# FISHERIES PRODUCTION

## SPINY LOBSTER



# PEOPLE BENEFIT IN MANY WAYS FROM FISH

natural  
capital  
PROJECT



JOBS AND LIVELIHOODS



FOOD



TOURISM AND  
RECREATION

CULTURAL HERITAGE





# INVEST FISHERIES MODEL

1. Estimate catch and revenue
2. Estimate changes in catch and revenue related to changes in habitat, fishing pressure, etc.





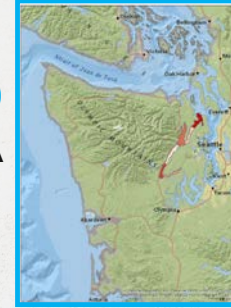
# INVEST FISHERIES MODEL

## LIBRARY OF SINGLE SPECIES MODELS

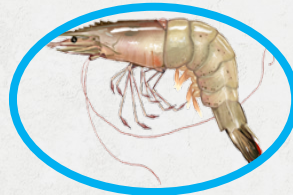
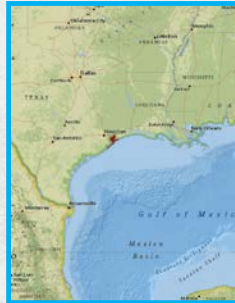
**Caribbean  
spiny lobster**  
Belize



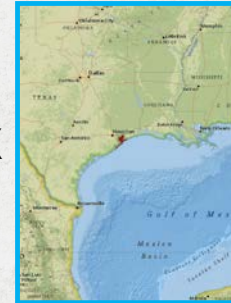
**Dungeness Crab**  
Hood Canal, WA



**White Shrimp**  
Galveston Bay, TX



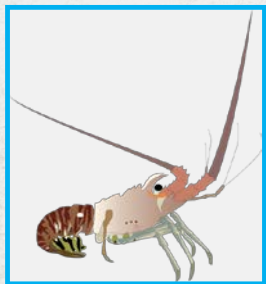
**Blue Crab**  
Galveston Bay, TX



# INVEST FISHERIES MODEL

## SPINY LOBSTER EXAMPLE

### INPUTS



#### **Life History**

Recruitment  
Age at maturity  
Migration  
Survival



#### **Fishery Behavior**

Fishing pressure  
Market value



#### **Habitat**

Where?  
How much?

### OUTPUTS



#### **Catch of spiny lobster**

(number/year)

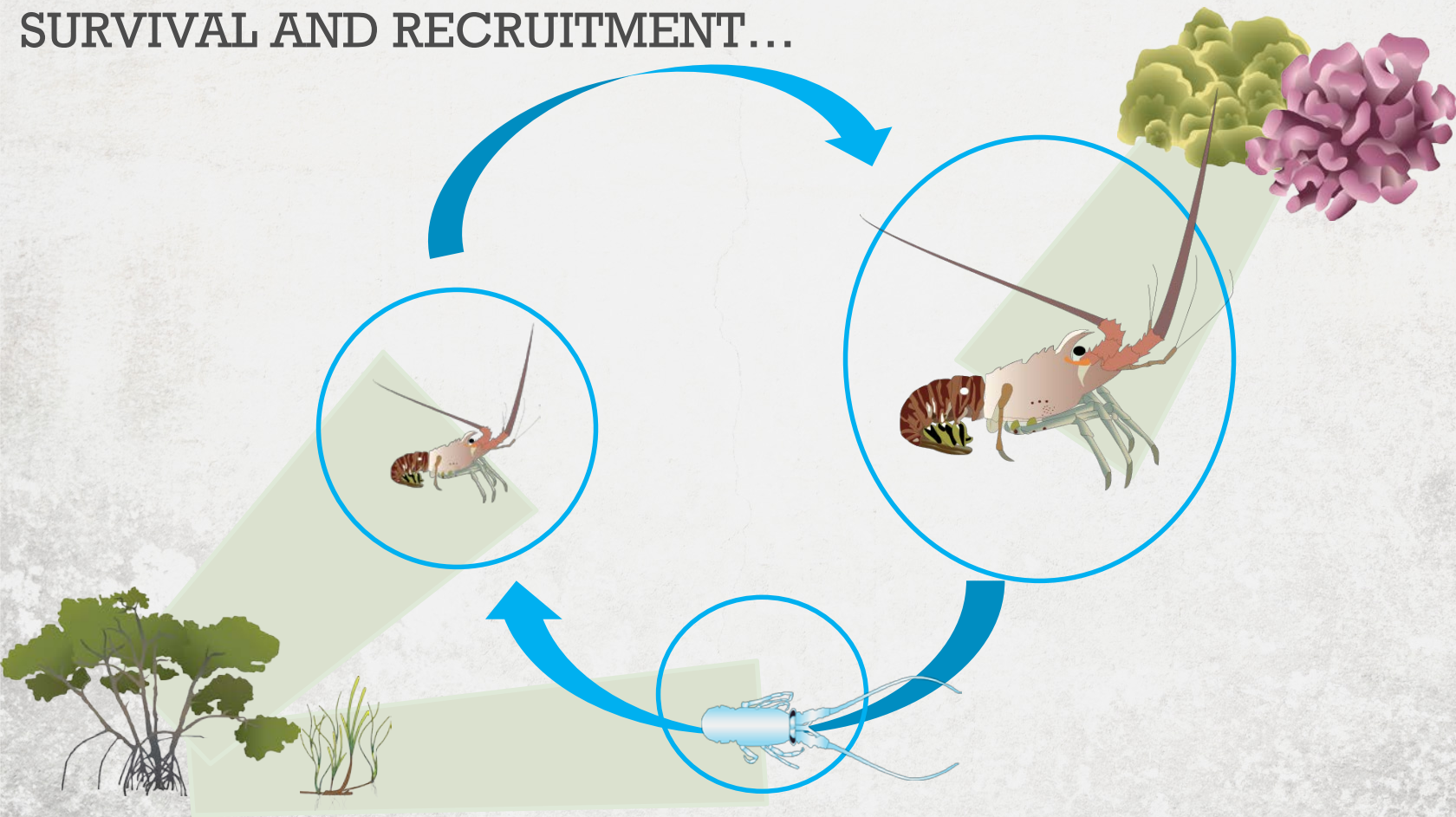


#### **Aggregate market value of catch**

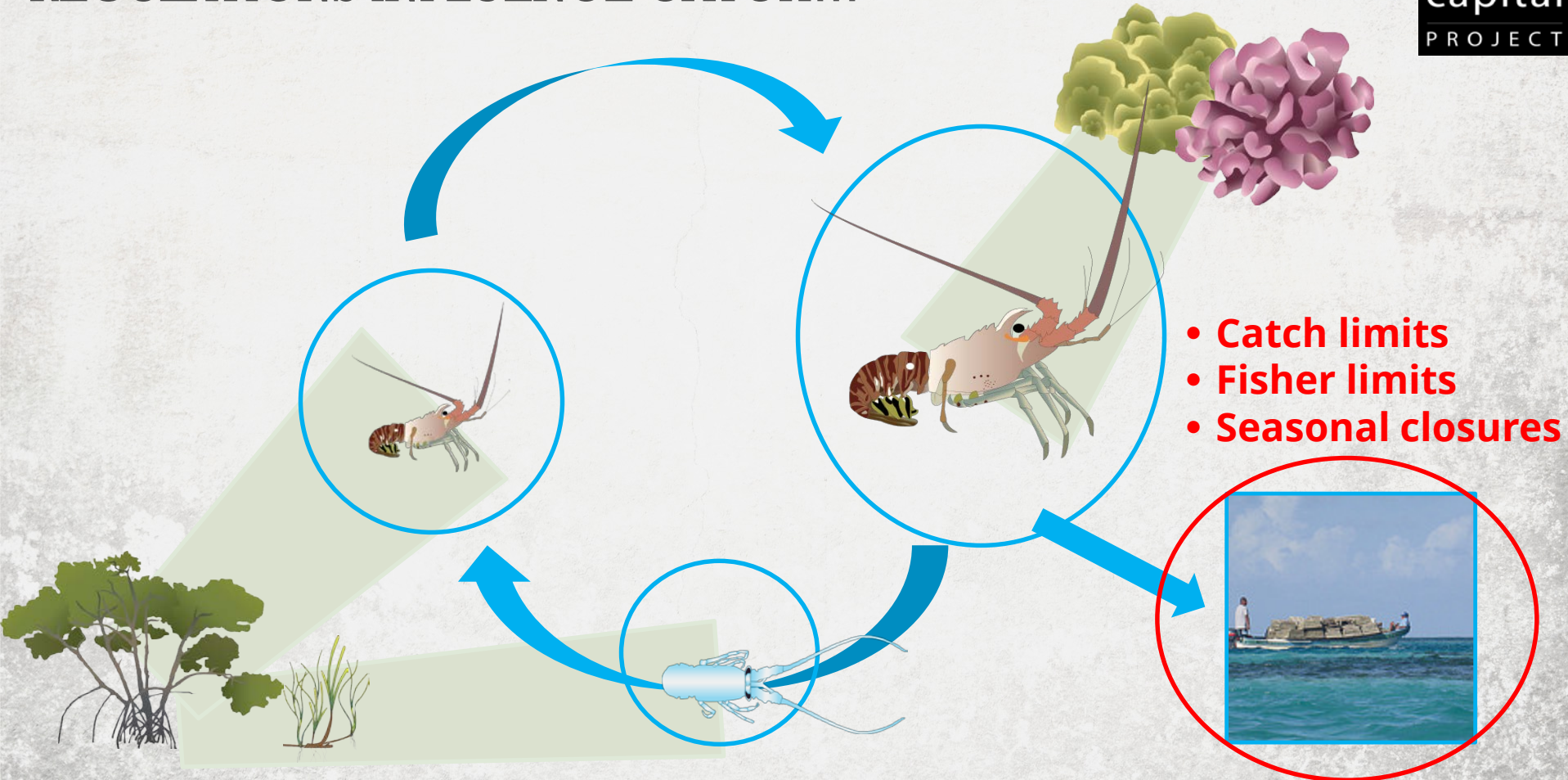
(\$/fishing zone/year)



# HABITAT INFLUENCES SURVIVAL AND RECRUITMENT...



# REGULATIONS INFLUENCE CATCH...





# AGE-STRUCTURED MODEL (8 CLASSES)

Recruitment function

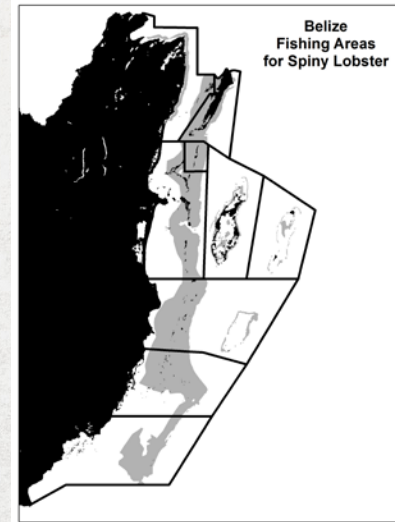
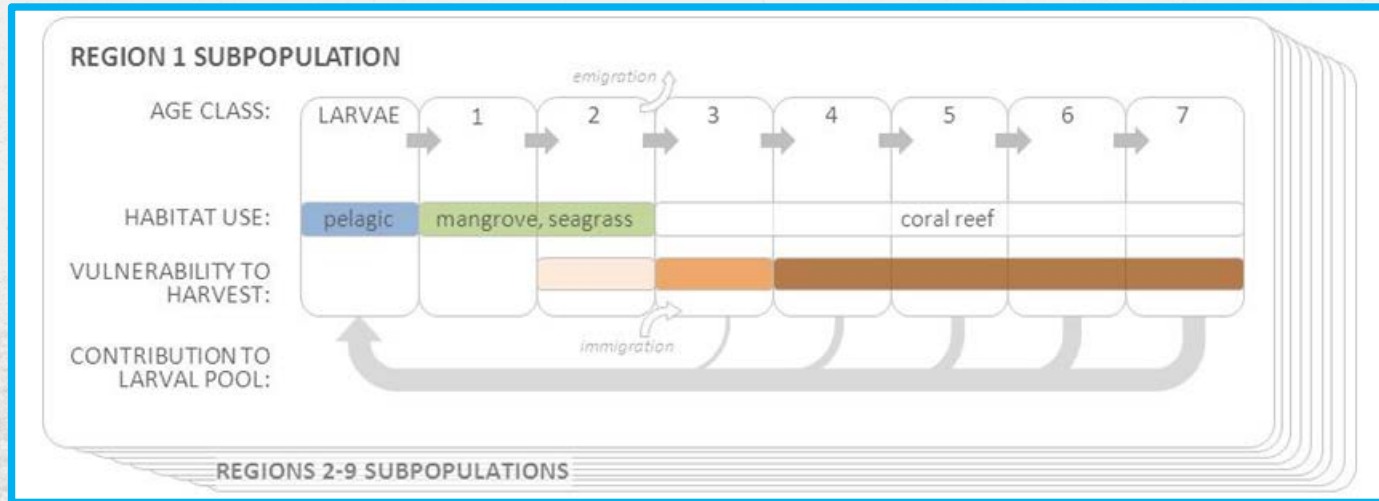
Habitats influence  
survivorship

$$N_{a,x,y+1} = \begin{cases} \frac{\sum_x SB_{x,y}}{SB_0} \left( \alpha + \beta \frac{\sum_x SB_{x,y}}{SB_0} \right)^{A-1} \frac{H_{h,x,SCEN}}{\sum_x H_{h,x,SCEN}} S_{a,x} & \text{if } a = 0 \\ (N_{a-1,x,y} - C_{a-1,x,y}) S_{a,x} & \text{if } 1 \leq a \leq A-1 \\ (N_{A-1,x,y} - C_{A-1,x,y}) S_{A,x} + (N_{A,x,y} - C_{A,x,y}) S_{A,x} & \text{if } a = A \end{cases}$$

Regulations influence catch

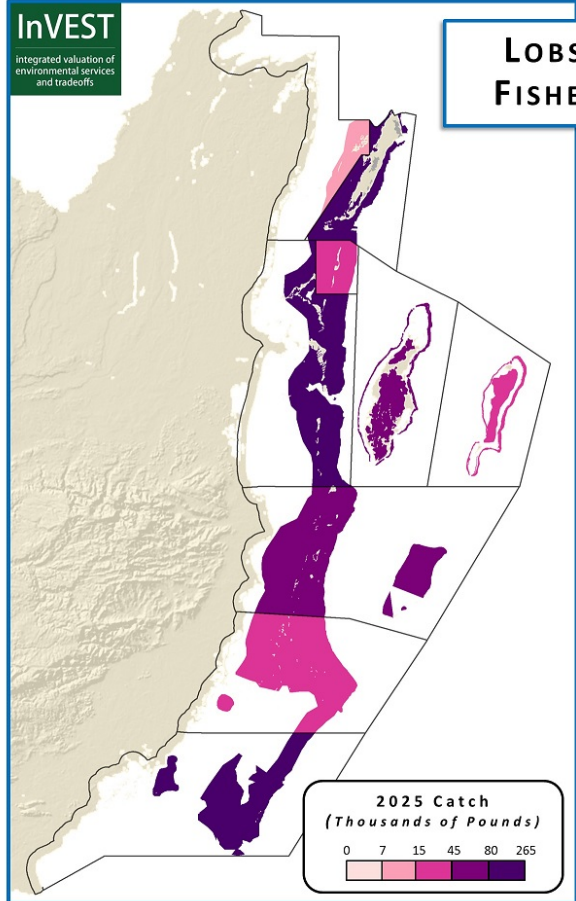


# MULTIPLE SUB-REGIONS



# LOBSTER FISHERIES

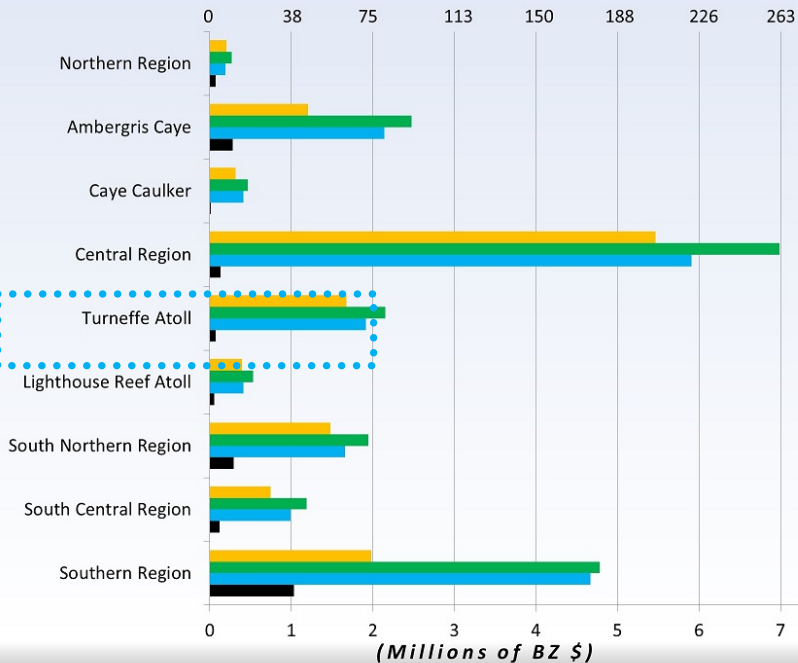
## SCENARIOS



INFORMED MANAGEMENT

## Catch and Revenue by Coastal Planning Region (Current & 2025)

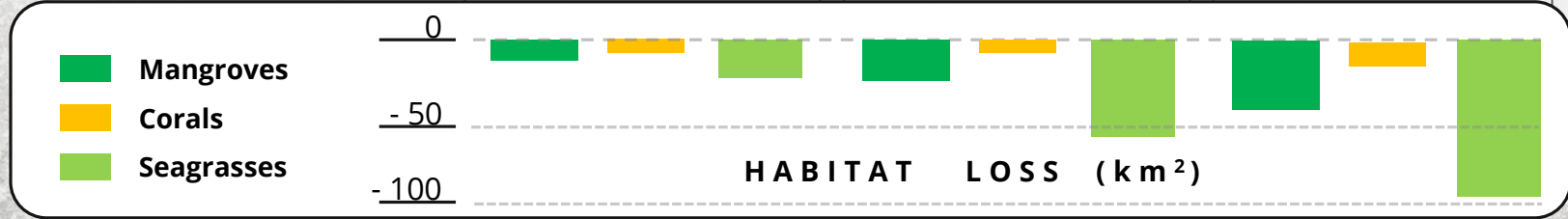
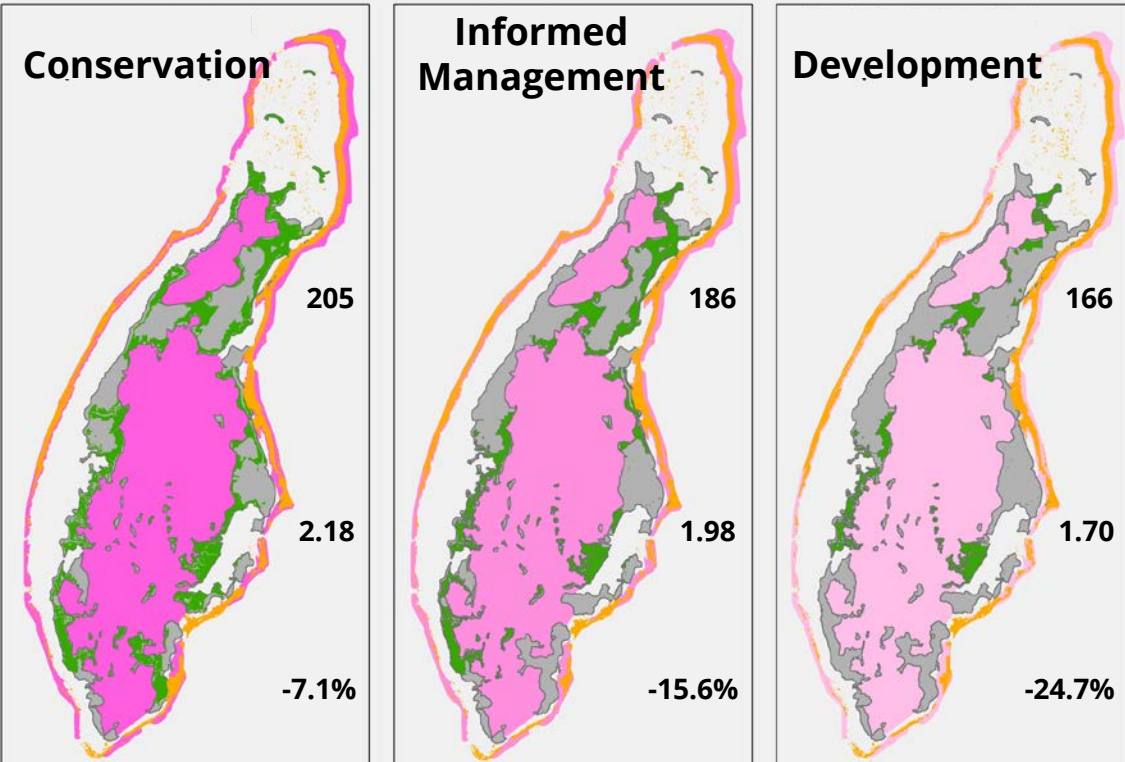
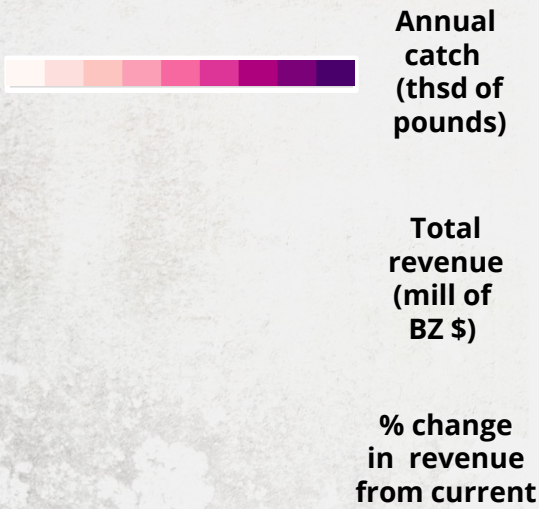
(Thousands of Pounds)





# TURNEFFE ATOLL

Year: 2025




# MODEL LIMITATIONS

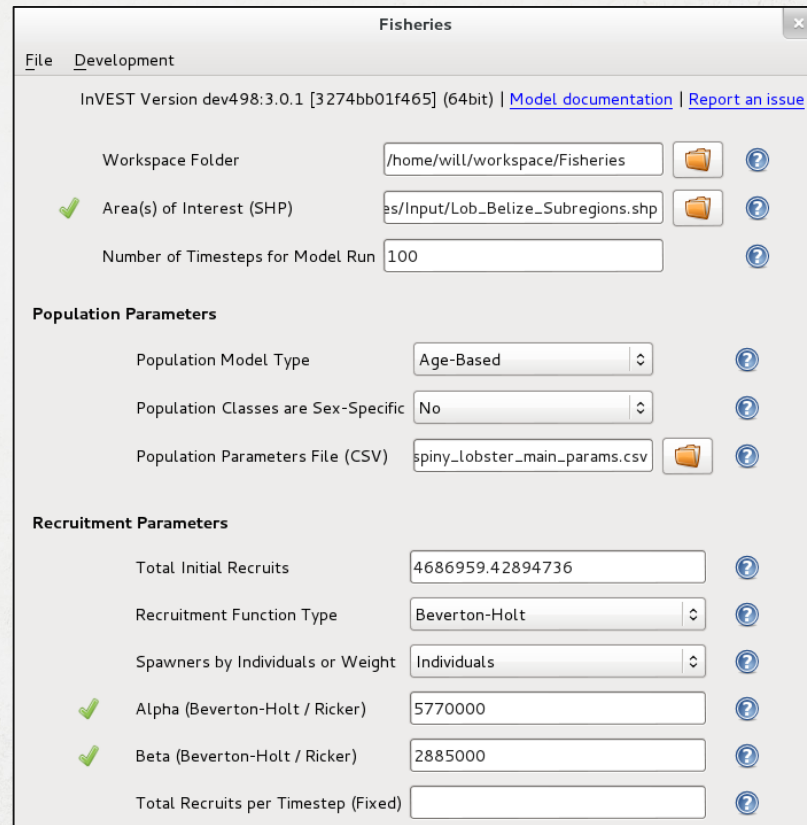
- Equilibrium model = good for scenarios, not for predicting next year's catch.
- Habitat dependencies are obligatory (i.e. habitat substitutability is not explicitly represented).
- Harvest rates are assumed to be constant (not responsive to abundance).
- Model must be adapted for each species/region.



# INVEST FISHERIES MODEL

FIND OUT MORE...

- It's in InVEST! 
- How it works
- Case study: Belize
- On the horizon: new approaches



The screenshot shows the 'Fisheries' application window with a 'Development' tab. At the top, it displays 'InVEST Version dev498:3.0.1 [3274bb01f465] (64bit)' and links for 'Model documentation' and 'Report an issue'. The main settings are organized into sections: 'Workspace Folder' (set to '/home/will/workspace/Fisheries'), 'Area(s) of Interest (SHP)' (checked, set to 'es/Input/Lob\_Belize\_Subregions.shp'), and 'Number of Timesteps for Model Run' (set to 100). Below these are 'Population Parameters' including 'Population Model Type' (Age-Based), 'Population Classes are Sex-Specific' (No), and 'Population Parameters File (CSV)' (spiny\_lobster\_main\_params.csv). The 'Recruitment Parameters' section includes 'Total Initial Recruits' (4686959.42894736), 'Recruitment Function Type' (Beverton-Holt), 'Spawners by Individuals or Weight' (Individuals), 'Alpha (Beverton-Holt / Ricker)' (5770000), 'Beta (Beverton-Holt / Ricker)' (2885000), and 'Total Recruits per Timestep (Fixed)' (empty). Each parameter has a help icon (question mark) to its right.

**Fisheries**

File Development

InVEST Version dev498:3.0.1 [3274bb01f465] (64bit) | [Model documentation](#) | [Report an issue](#)

Workspace Folder: /home/will/workspace/Fisheries

Area(s) of Interest (SHP): es/Input/Lob\_Belize\_Subregions.shp

Number of Timesteps for Model Run: 100

**Population Parameters**

Population Model Type: Age-Based

Population Classes are Sex-Specific: No

Population Parameters File (CSV): spiny\_lobster\_main\_params.csv

**Recruitment Parameters**

Total Initial Recruits: 4686959.42894736

Recruitment Function Type: Beverton-Holt

Spawners by Individuals or Weight: Individuals

Alpha (Beverton-Holt / Ricker): 5770000

Beta (Beverton-Holt / Ricker): 2885000

Total Recruits per Timestep (Fixed):