Carrying capacity estimation in common water bodies

Case studies in the Philippines

USSEC Southeast Asia Regional Symposium on Aquaculture Carrying Capacity Modeling for Common Water bodies

10-13 June 2013 Bangkok, Thailand

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Scope of the presentation

- Aquaculture park development
- Planning sustainable aquaculture
  - Minimising aquaculture impact on the environment
  - Optimising aquaculture production
- Integrated Multi-Trophic Aquaculture

AQUA PARK

Planning and management of aquaculture parks for sustainable development of cage farms in the Philippines

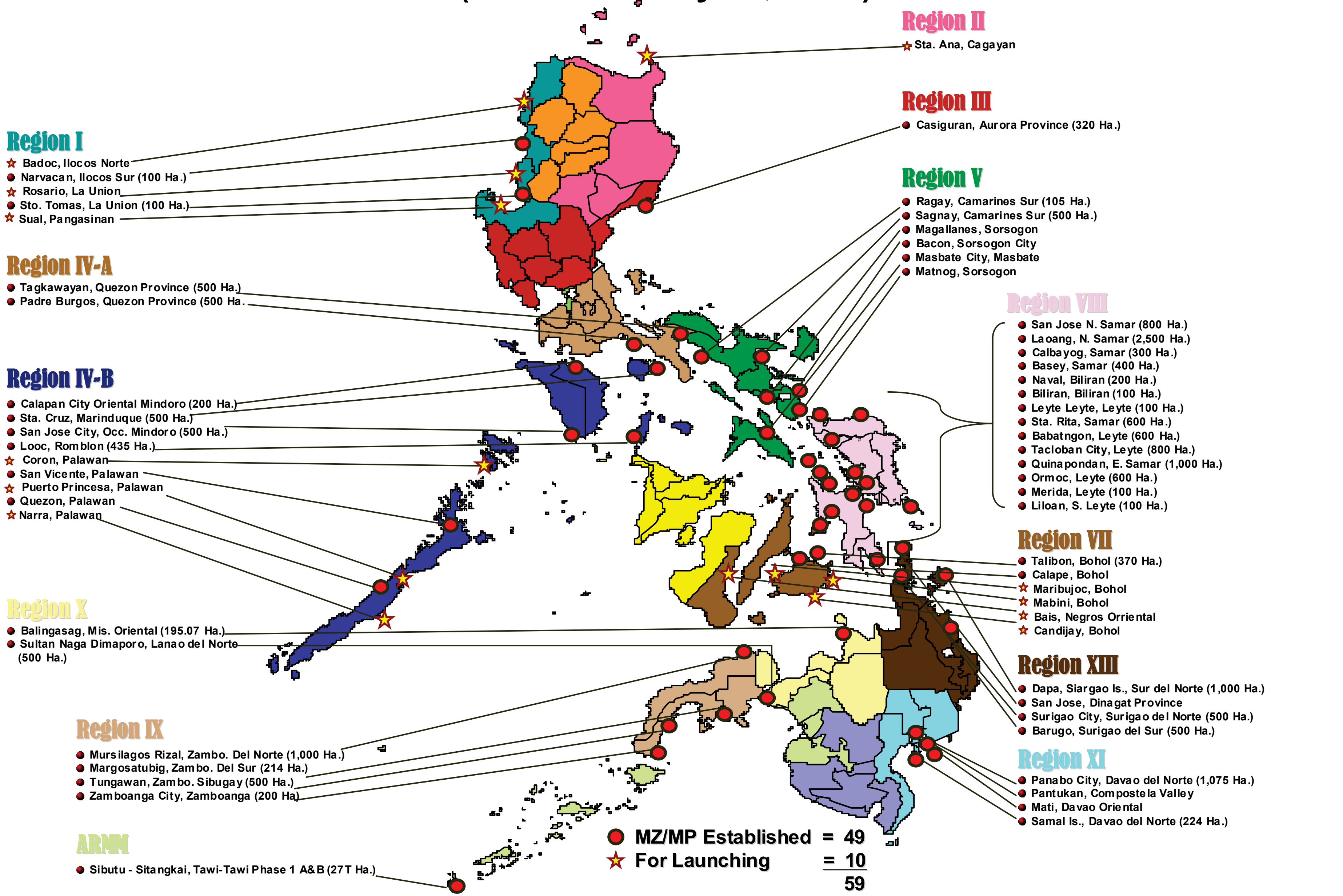
Partners
BFAR, NIFTDC, Map and Marine, Akvaplan-niva

Funded by Norad, Norway

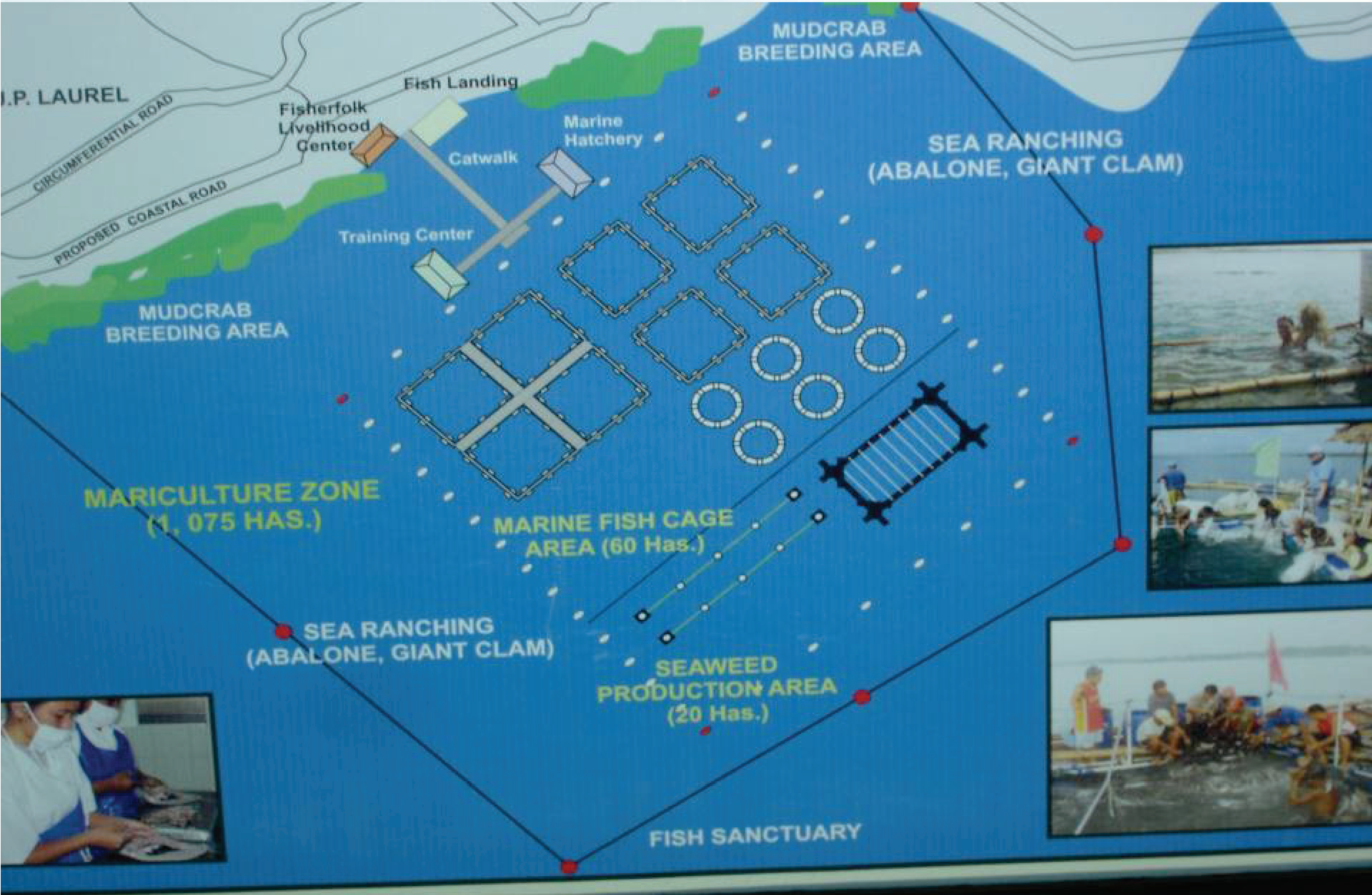
www.aqua-park.asia

Location of Existing Mariculture Park/Zone

(As of February 18, 2010)



Initial Concept of Panabo Mariculture Park

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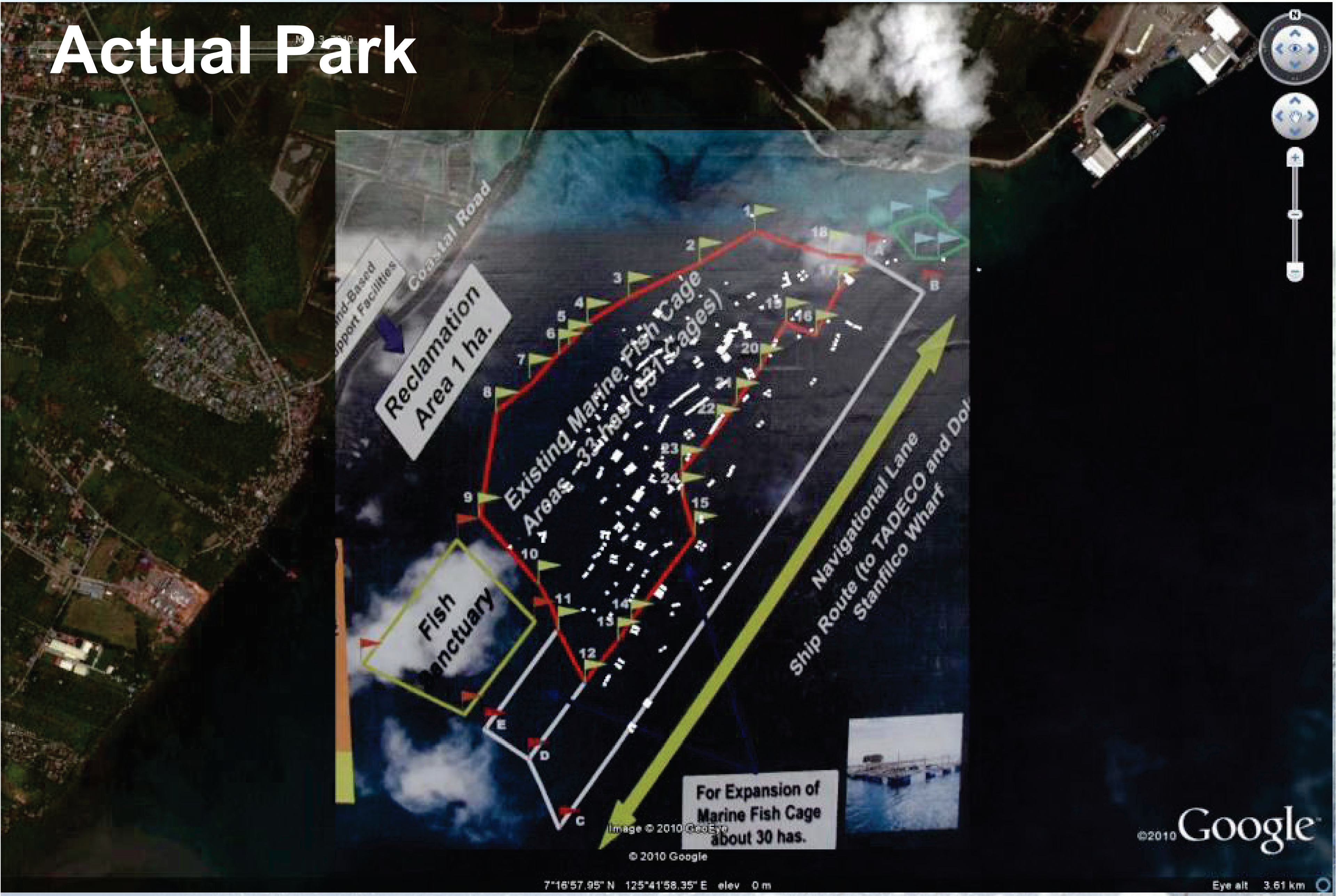
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 GeoEye
Image © 2010 TerraMetrics
7°17'03.35" N 125°42'08.36" E elev 0 m
Eye alt 3.36 km
©2010 Google

Actual Park



Coastal Road
Land-Based Support Facilities
Reclamation Area 1 ha.
Existing Marine Fish Cage Areas ~33 has (351 Cages)
Fish Sanctuary
Navigational Lane
Ship Route (to TADECO and Dole Stanfilco Wharf
For Expansion of Marine Fish Cage about 30 has.
Image © 2010 GeoEye
© 2010 Google
©2010 Google
7°16'57.95" N 125°41'58.35" E elev 0 m
Eye alt 3.61 km

Using modelling for planning for sustainable development

- Reorganisation of the Mariculture Park to reduce environmental impact
- Planning for further expansion (modelling for exposure)
- Integrating fed production with unfed production – IMTA (recapture of nutrients and provide further livelihoods)

Optimisation Process

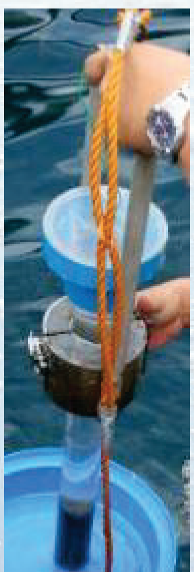
- Data collection
  - Production survey – actual tonnes produced
  - Environmental survey – actual impact caused
- Modelling
  - Environmental impact
  - Location of extractive species
- Optimisation
  - cage layout
  - Inclusion of Integrated Multi-trophic aquaculture (fish, oysters and seaweed)
  - Expansion in deeper area with larger cages

Production survey - Total biomass of species

Total biomass of species culture at Panabo City Mariculture Park

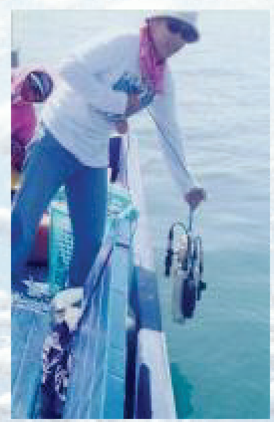
Environmental survey

- Analysis of the bathymetry of the area
- Profiling of temperature, salinity, and oxygen levels through the water
- Sediment analysis
- Survey of current speed and direction

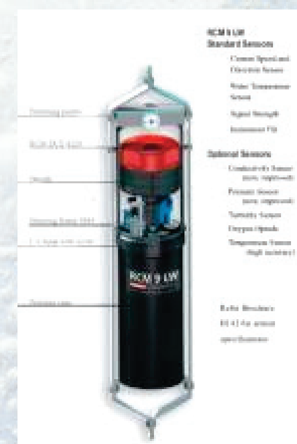


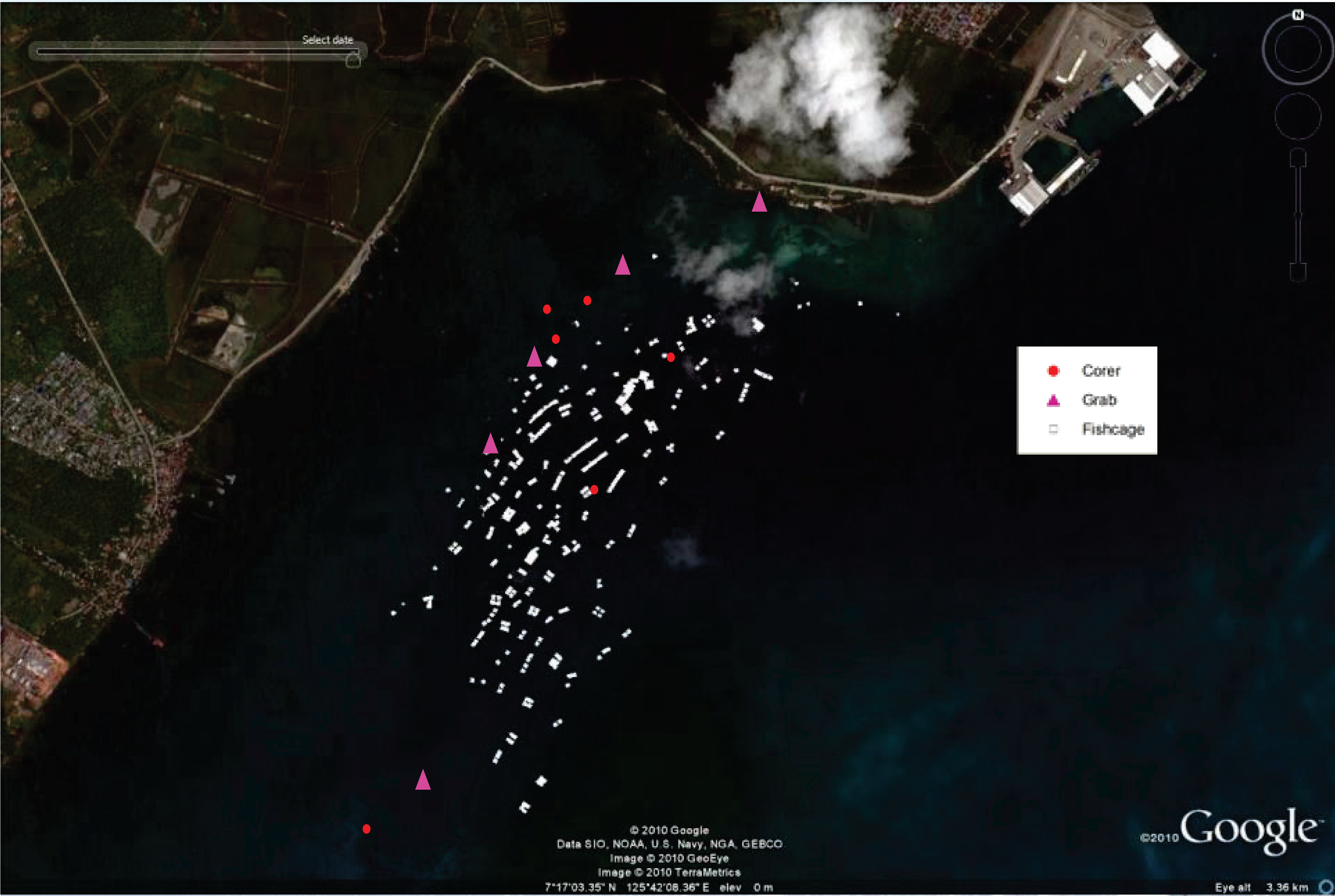
Grab

CTDO



Current meter

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Corer
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Fishcage
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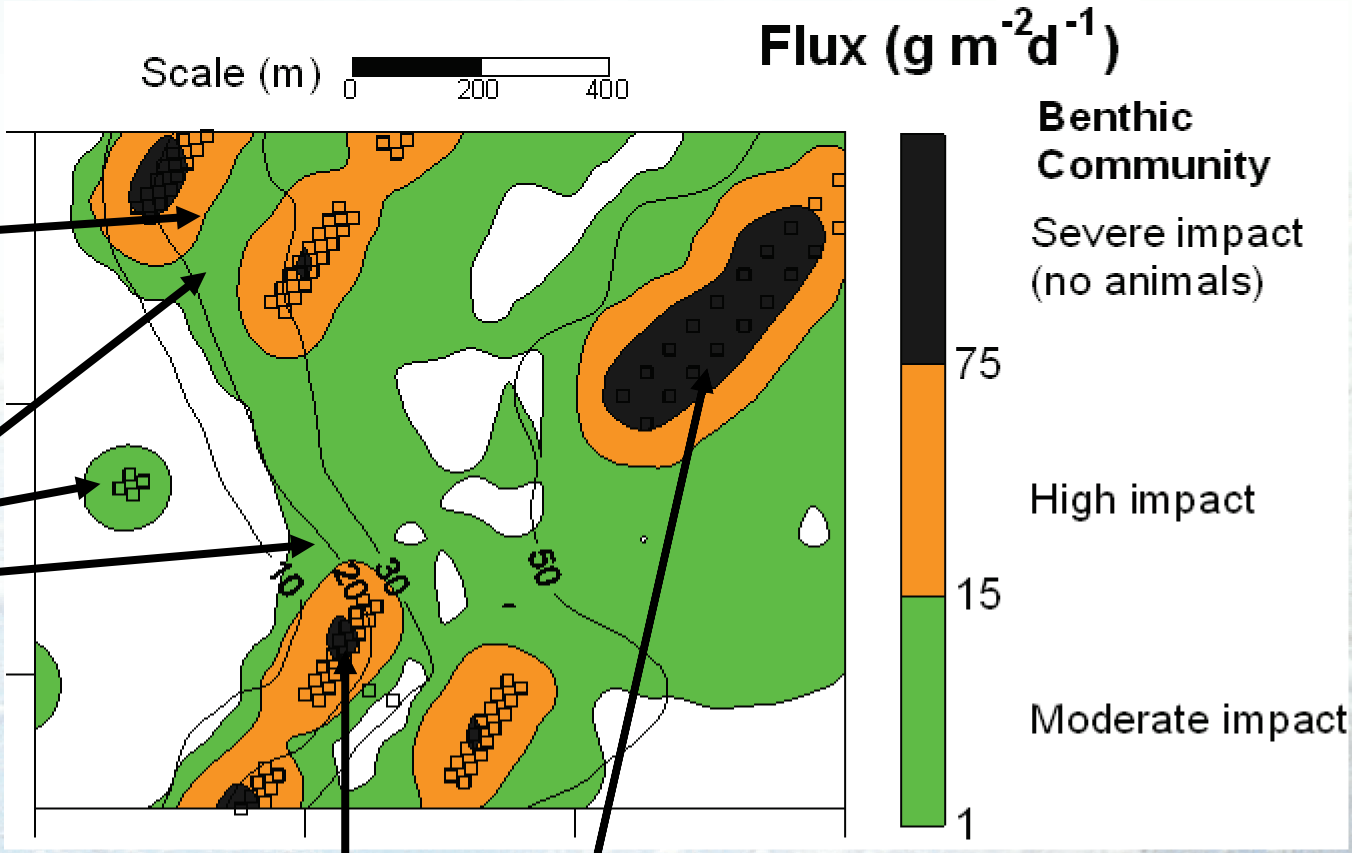
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 GeoEye
Image © 2010 TerraMetrics
7°17'03.35" N 125°42'08.36" E elev 0 m
©2010 Google
Eye alt 3.36 km

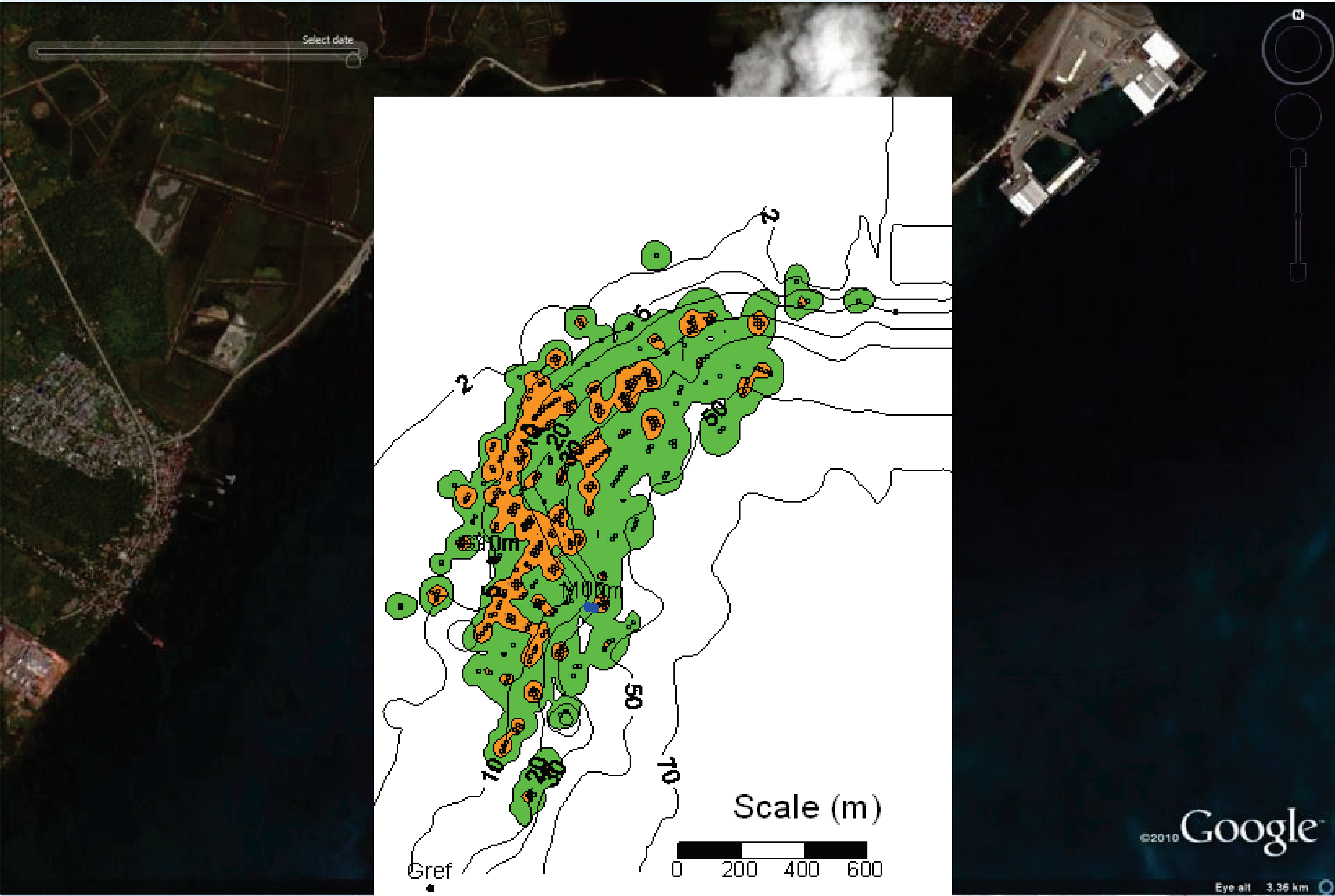
Modelling environmental impact - TROPOMOD

HIGH impact (orange) close to clusters of cages

MODERATE impact (green) away from cages or around small clusters of cages



SEVERE impact (grey) under clusters of cages or under large cages



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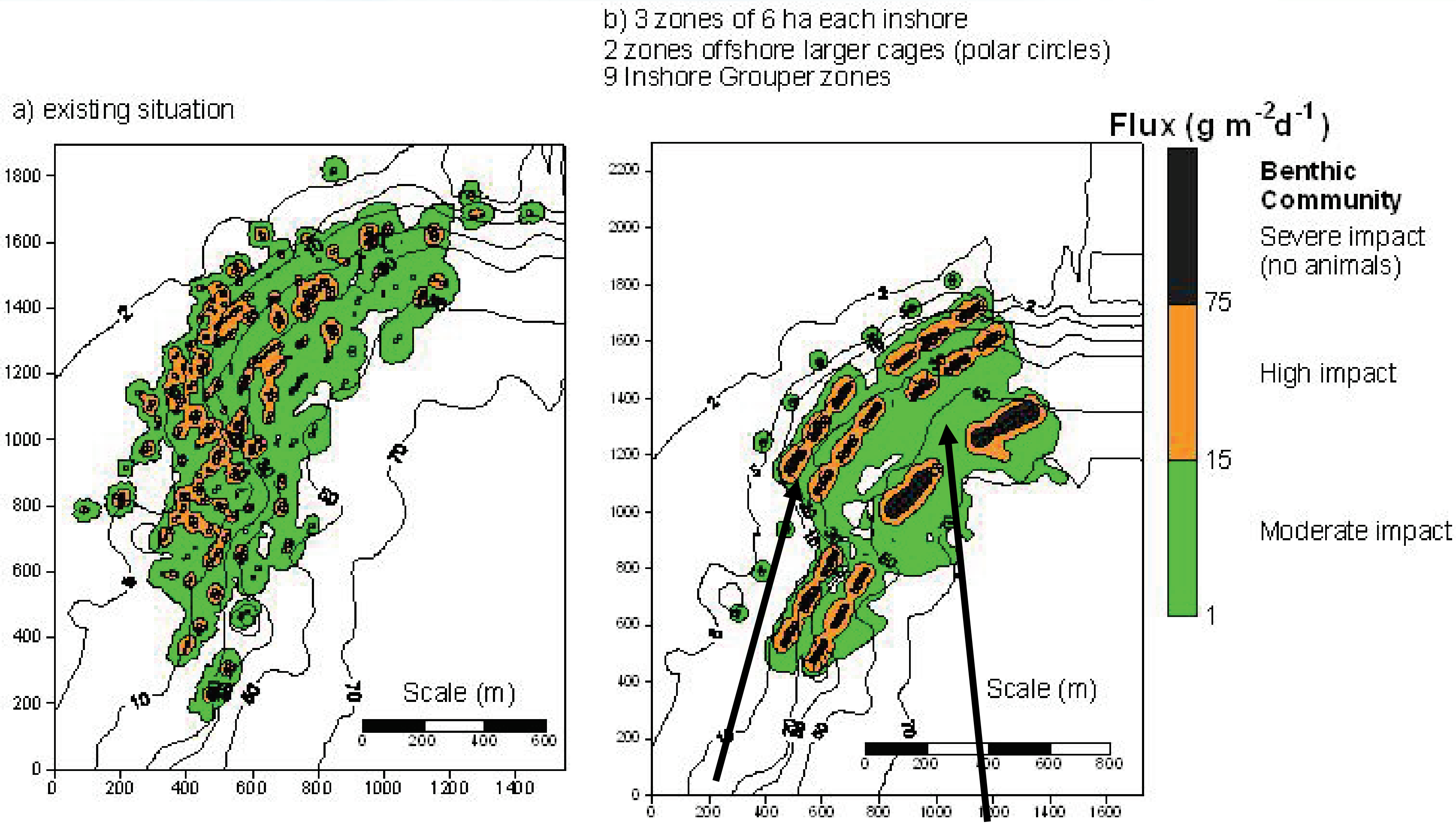
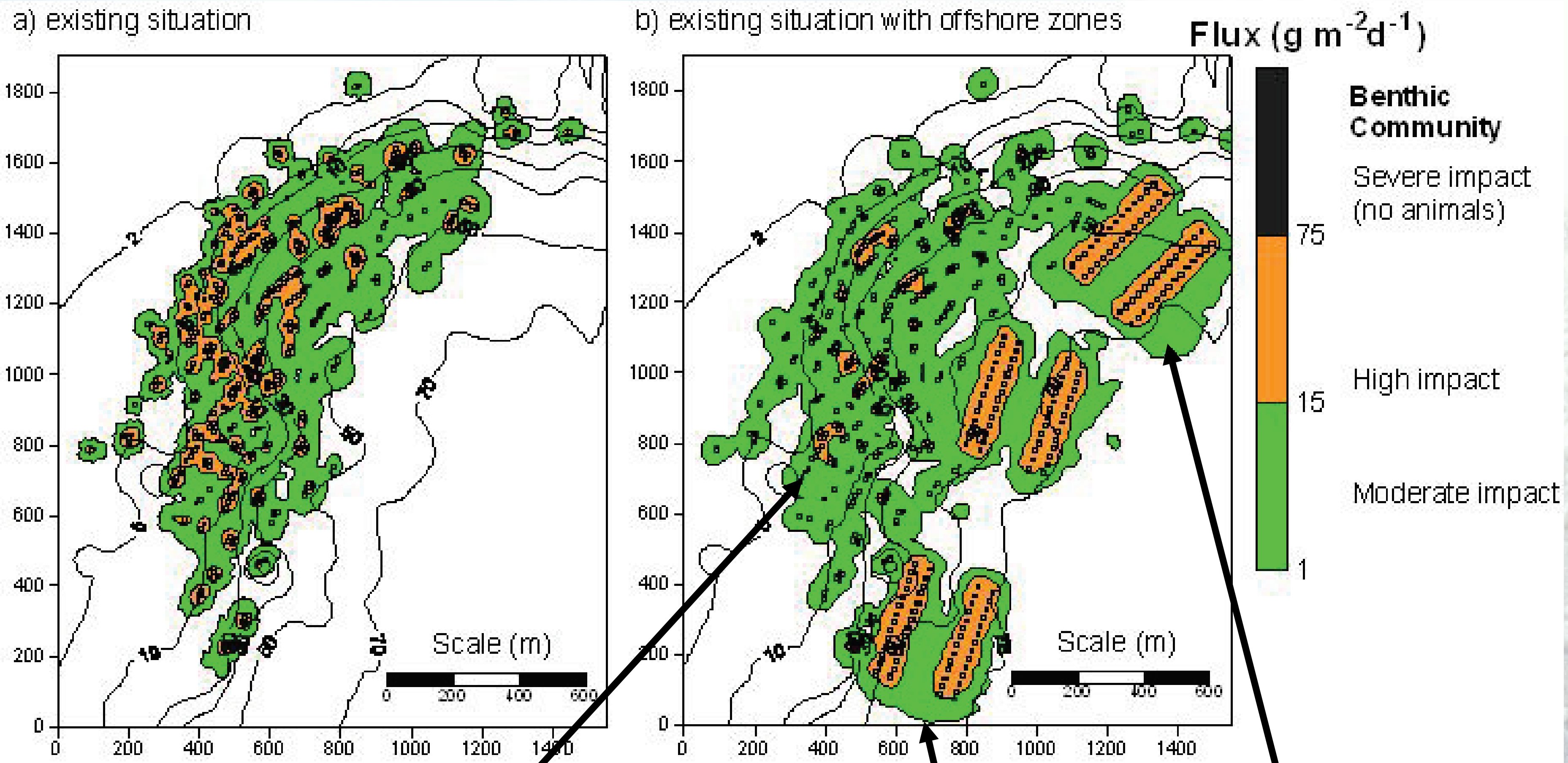
Panabo AquaPark – Existing and reorganised



Spacing between zones results in less impact and also more space for IMTA units

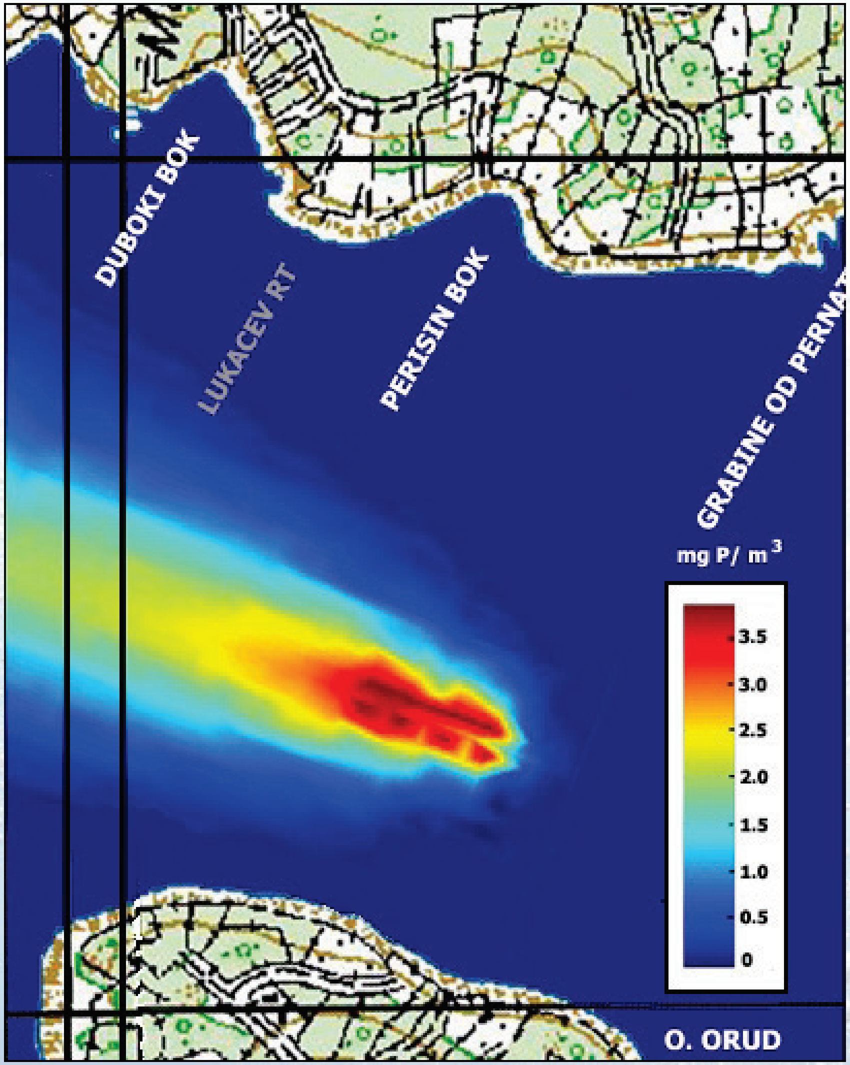
Panabo AquaPark – Existing and offshore zones added

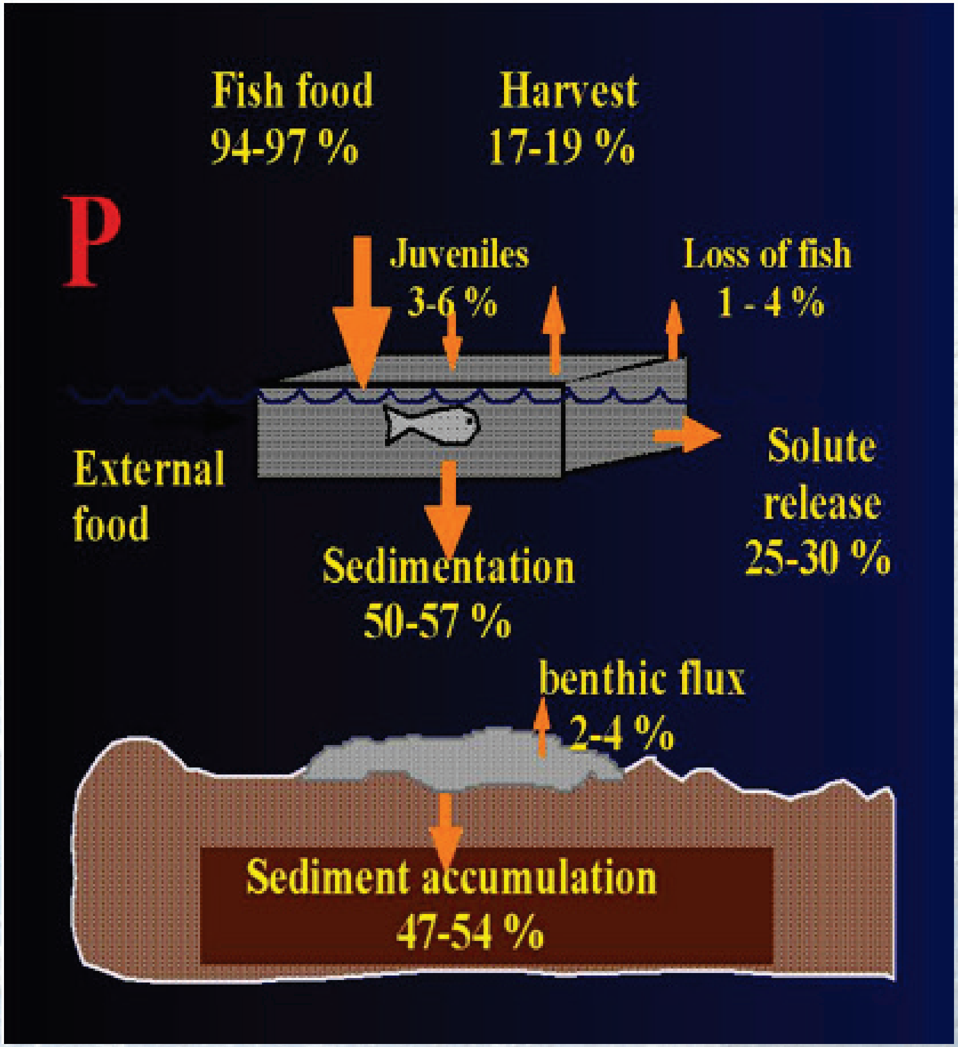


Good feeding scenario improves inshore areas

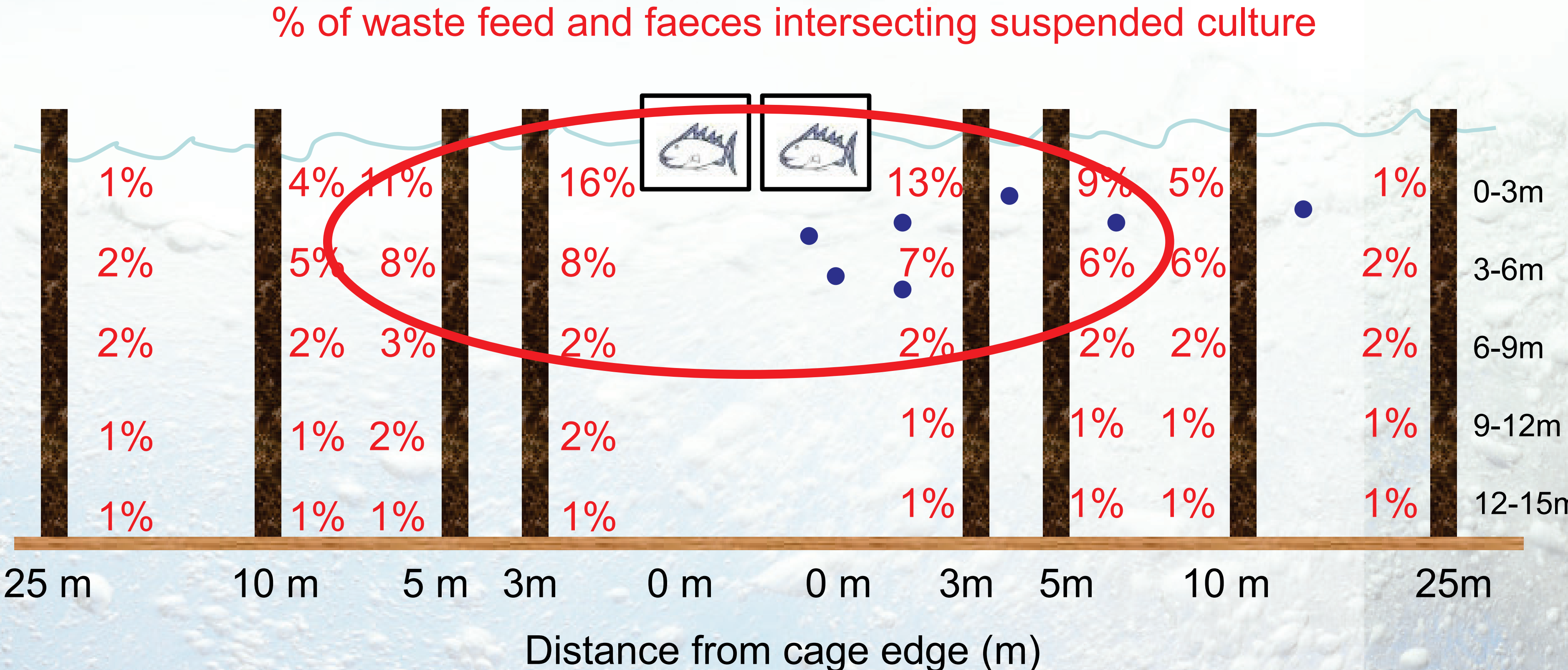
Offshore Milkfish zones in deeper areas results in good dispersion

Nutrient budget and fate



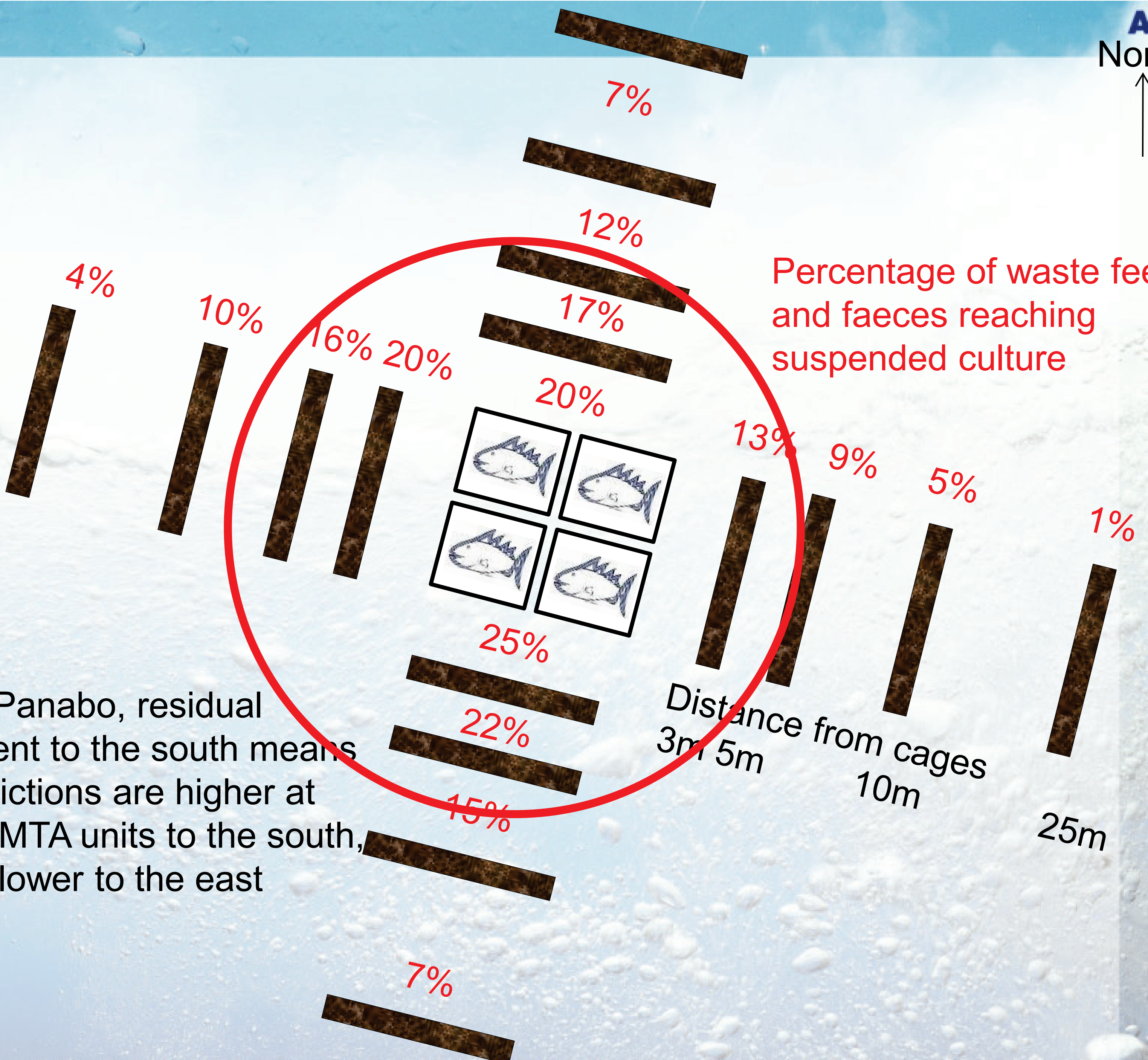


Suspended solids reaching suspended oyster culture at different depths



The majority of the wastes intersect the suspended culture in the top 6 m; these wastes are mostly fine and slow settling Milkfish faeces

Net depth is important when considering optimum depth of suspended culture

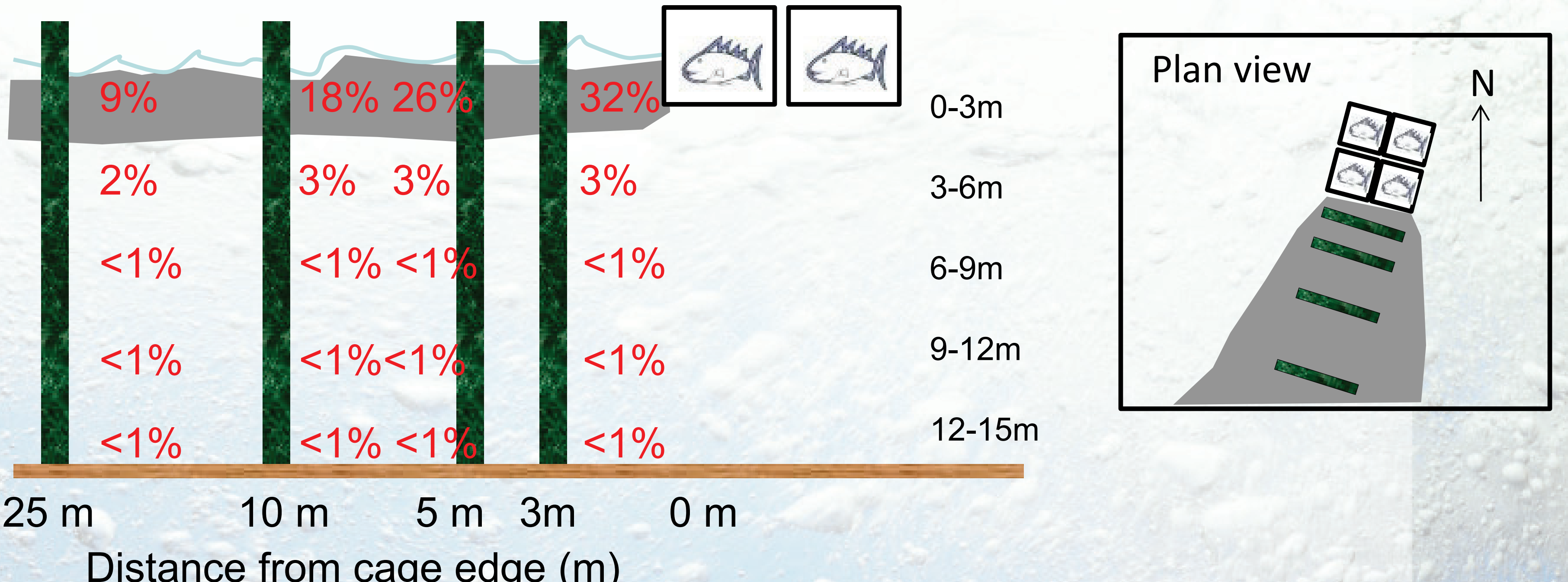


Percentage of waste feed and faeces reaching suspended culture

For Panabo, residual current to the south means predictions are higher at the IMTA units to the south, and lower to the east

Dissolved nutrient plume reaching <u>seaweed culture</u>

% of plume intersecting seaweed culture to the SOUTH of the cages

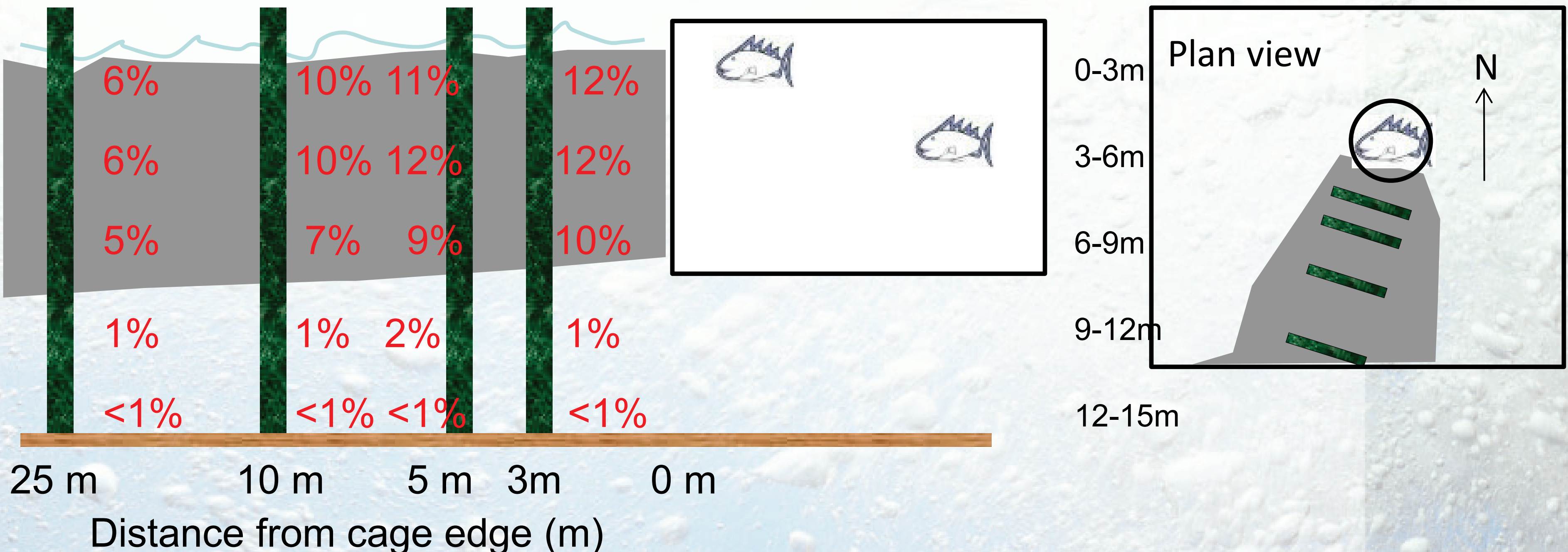


More of the plume intersects seaweed culture to the south of the cages as this is the direction of the residual current

Net depth is important when considering optimum depth of seaweed culture

Nutrient plume from a large polar circle cage reaching seaweed culture

% of plume intersecting seaweed culture to the SOUTH of the cages

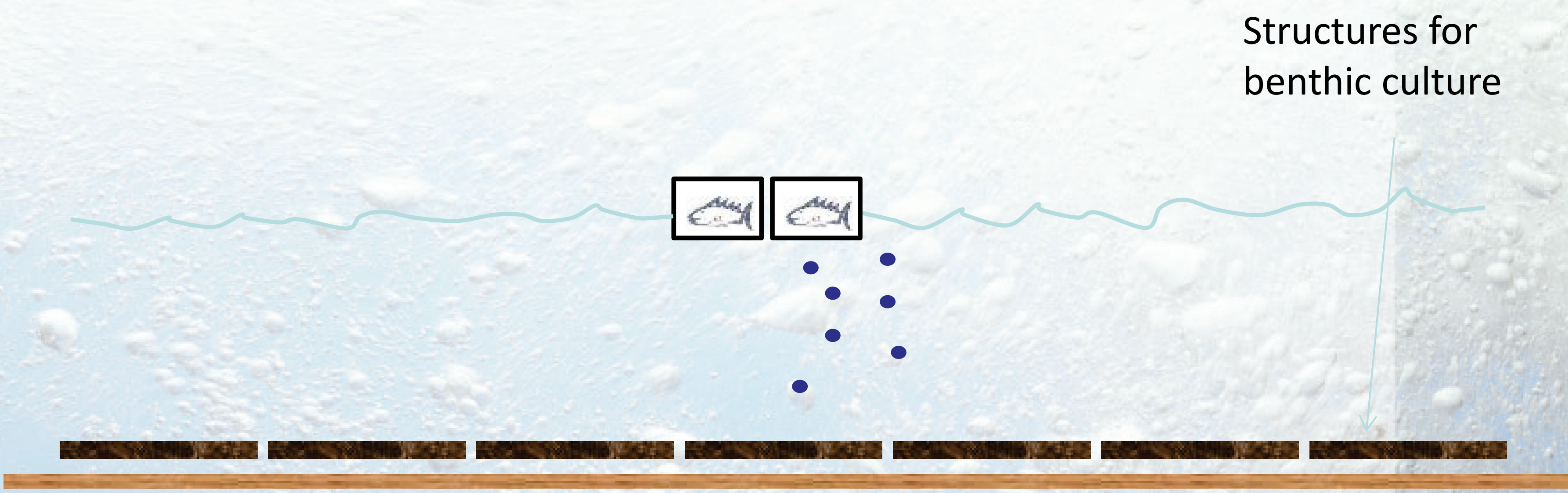


A deeper net means more of the suspended line comes into contact with the plume

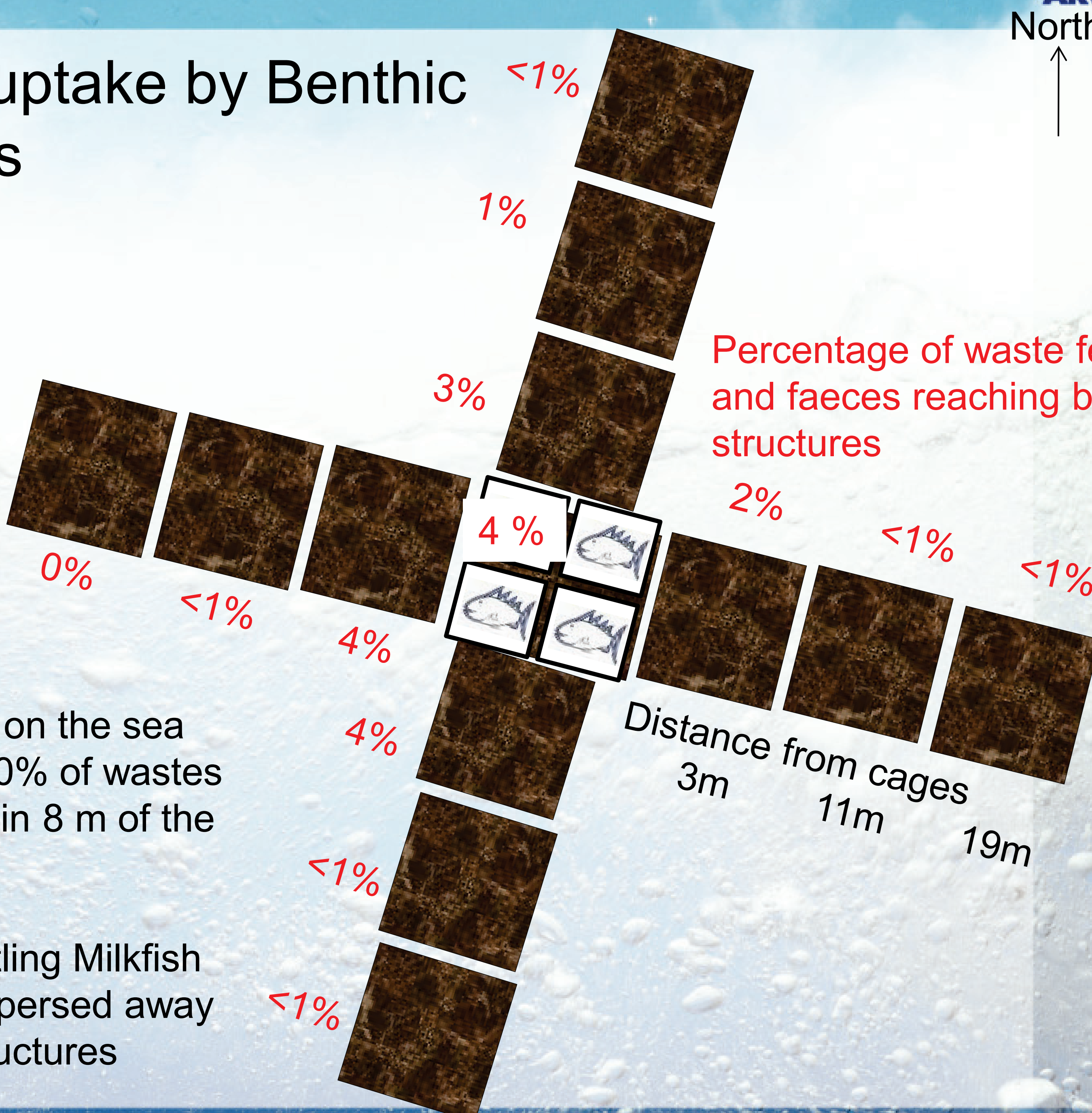
Seaweed culture at depth will be limited by light rather than nutrients

Suspended solid nutrient uptake by benthic structures

TROPOMOD predictions of the waste feed and faeces depositing on 8 m by 8 m structures on the sea bed



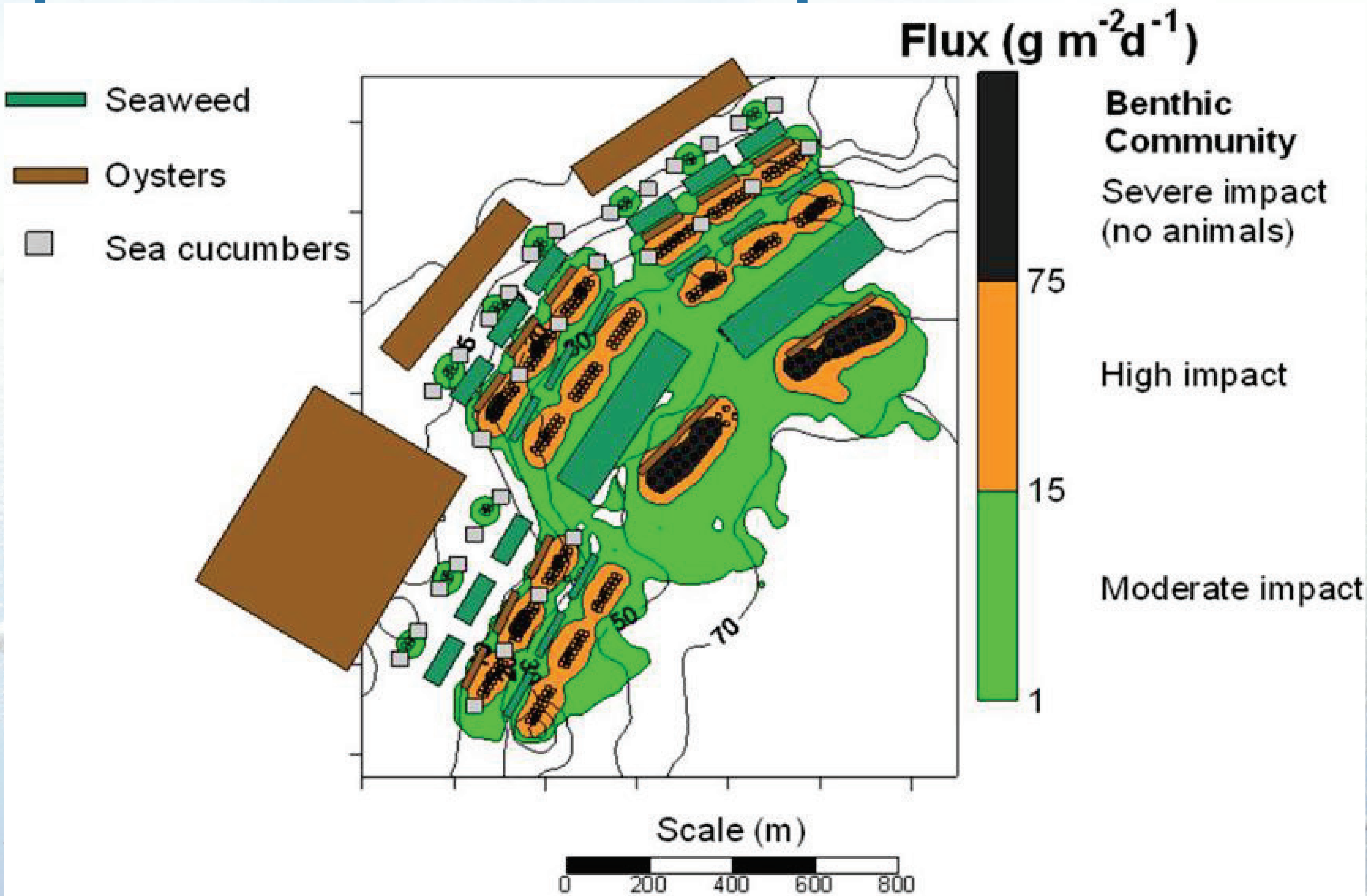
Nutrient uptake by Benthic structures



For structures on the sea bed, around 20% of wastes deposited within 8 m of the cages

Fine, slow settling Milkfish faeces are dispersed away from these structures

Optimised Mariculture park with IMTA



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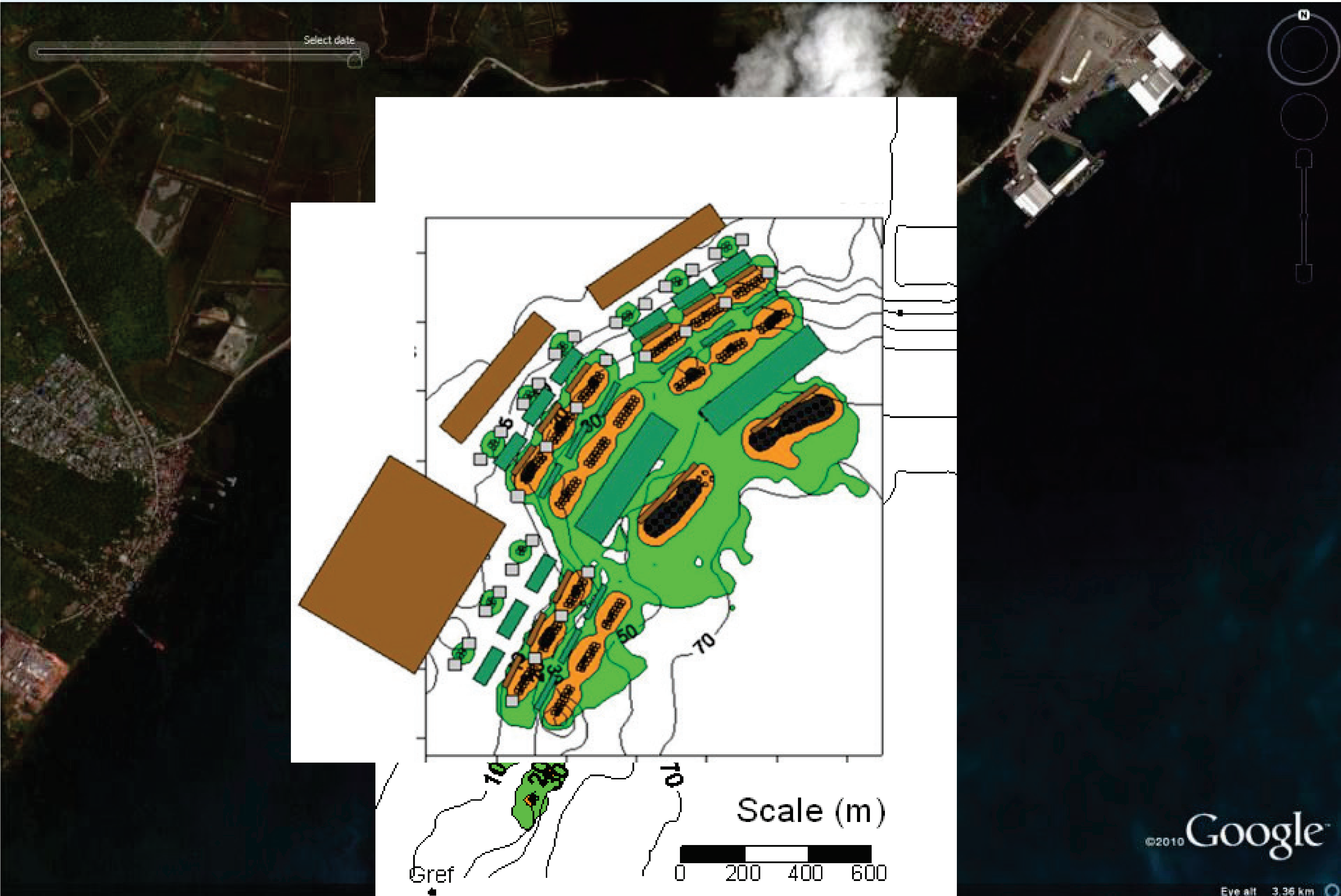


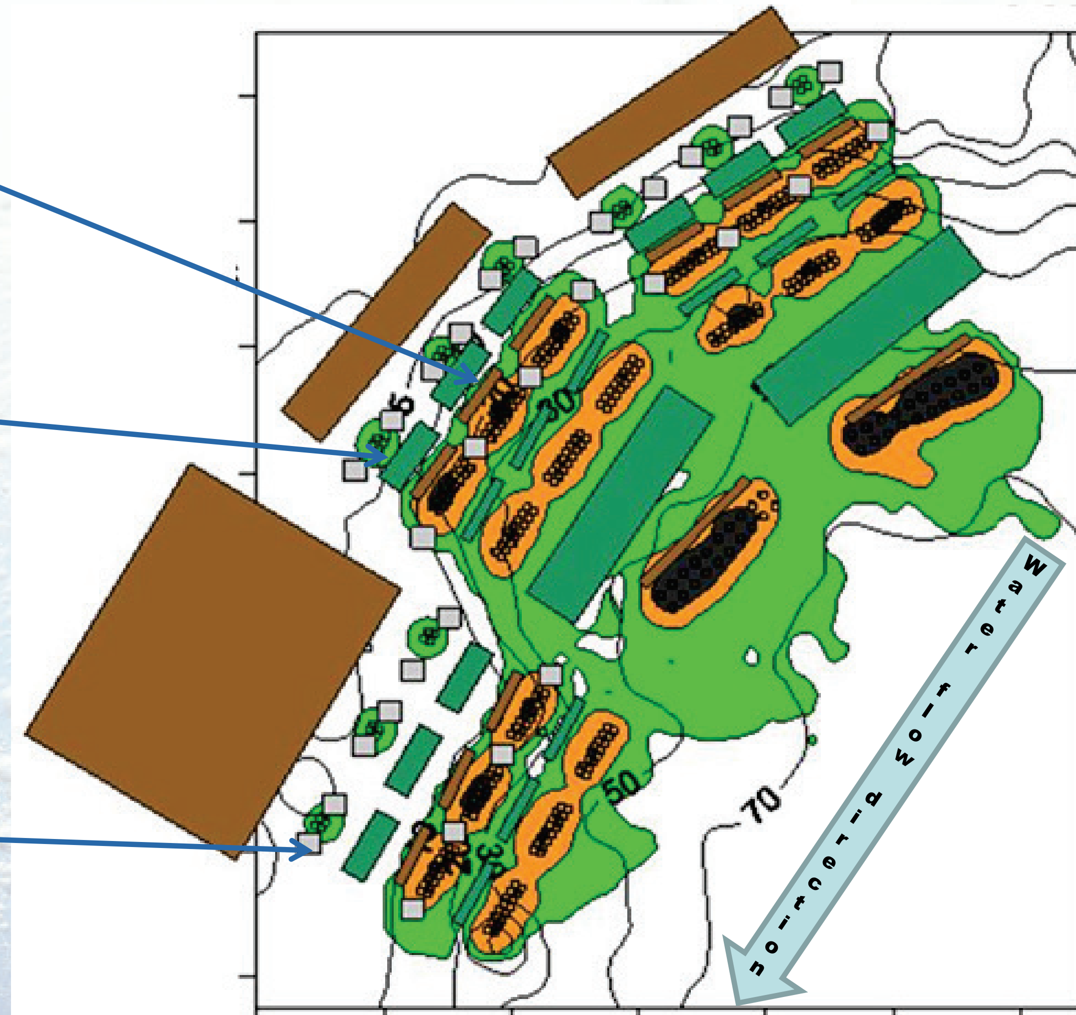
Optimal location of extractive species

Seaweed, oysters and sea cucumbers

Suspended oyster culture – located 10+ m from cage groups along the axis of group

Shallow seaweed culture – located 10+ m from cage groups along the axis of group

Benthic culture – optimum location at end of cage groups, but not directly underneath



The four dimensions of carrying capacity

Fed aquaculture	Extractive aquaculture
Bathymetry/Pond structure Hydrodynamics Land use/Infrastructure etc	Bathymetry Currents Temperature etc
Feed FCR/FCE/Wastage Markets etc	Plankton Detritus Markets etc
Mass balance models Hydrographic models Community structure etc	Mass balance models Hydrographic models Community structure etc
Employment Visual impacts Recreation Charismatic species Traditional fisheries etc	Employment Visual impacts Recreation Charismatic species Traditional fisheries etc

Ross et al., 2013 in Press

The Ecosystem Approach of Aquaculture is a Strategy that has these three objectives at the core

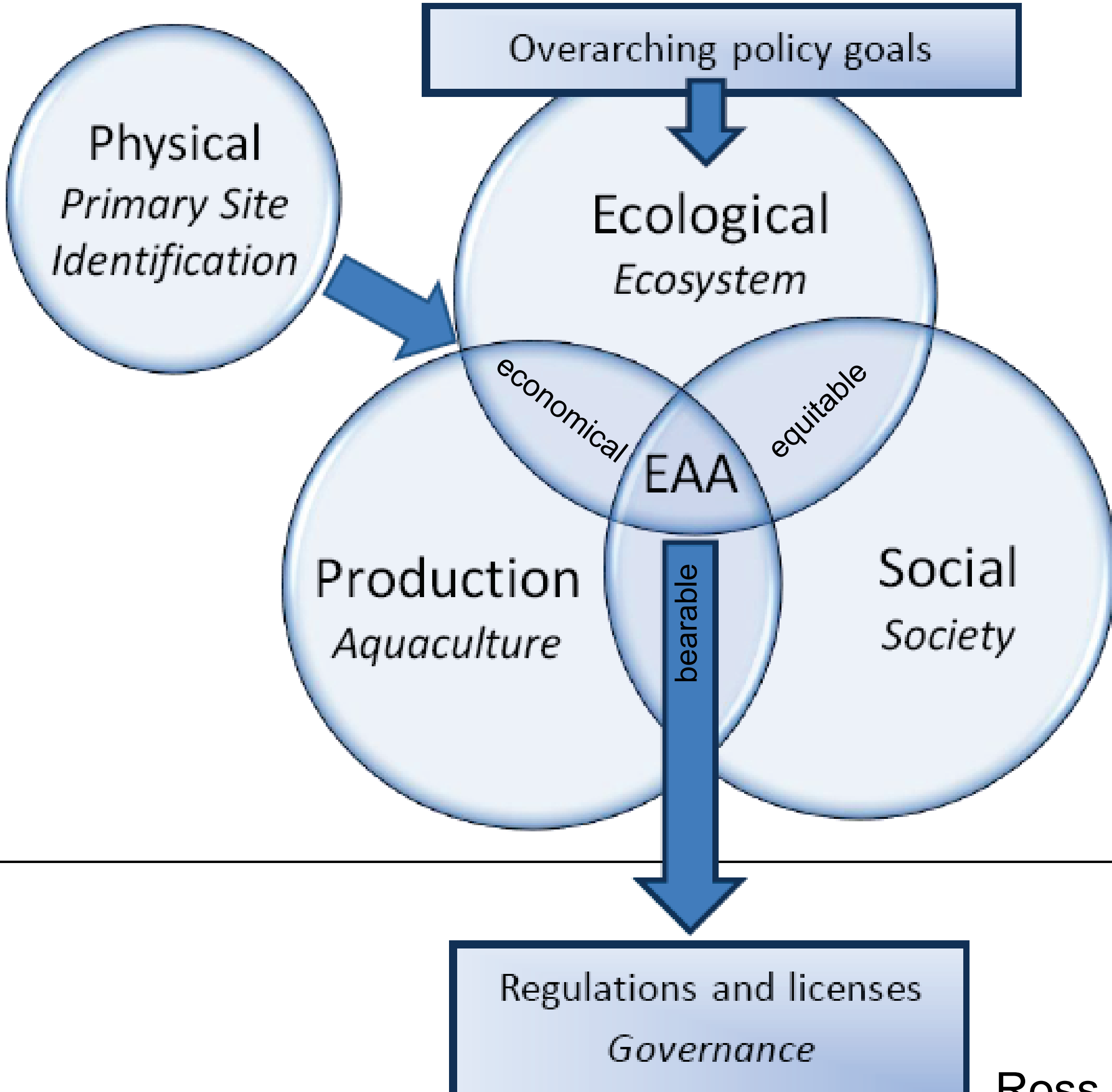
Ensuring ecological well being

Ensuring human wellbeing

Ensuring the ability to achieve both (governance)

Takes into consideration, different scales, Carrying capacity, transboundary issues

Fig. 2: Interaction of the different categories of carrying capacity can be considered within the Ecosystem Approach to Aquaculture.



Ross et al., 2013 in Press

Fig. 3. **Schematic approach to the relationships and possible sequencing of the different carrying capacity categories, showing the range of end-points in the decision process.**