

At what stages can we  
perform NbS retrofitting?



# Retrofitting using NbS

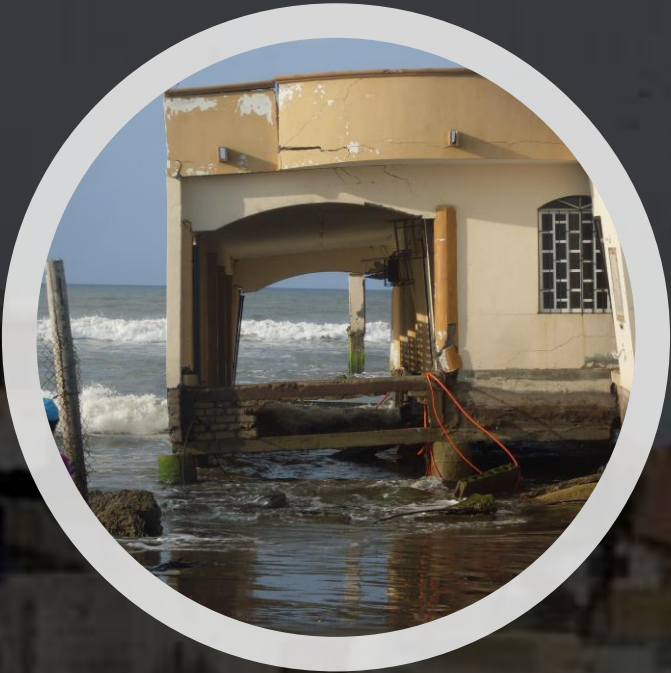
- Coastal ecosystems provide environmental services that support adaptation to climate change.
- NbS use the benefits provided by ecosystems to reduce flood and erosion risk due to natural hazards or bad planning.
- NbS contribute to increasing resilience of coastal areas while providing numerous cobenefits such as habitat for species, carbon storage, recreation areas, support fisheries and water quality.
- In this context, retrofitting refers to actions that improve the performance or integrity of a coastal defense system through NbS.



- Protection against flooding
- Protection against erosion
- Carbon sinks
- Regulate water cycle
- Habitat
- Support fisheries
- Recreation

# But, why is retrofitting necessary?

- Retrofitting of a coastal defense system is typically done as a preventive measure or after it has suffered damage.
- Aren't coastal defense systems constructed in such a way that they won't need these changes?
- Besides the natural lifespan of any structure, another reason is that our knowledge of coastal protection alternatives, including both methods and materials, continues to improve, as does our knowledge of hazards and their effects.
- Also, in developing countries such as Mexico, many coastal defense systems and developments were built with little regard for land use and ecological regulations, or consideration of the actual coastal processes, so that little was known about where and how often floods and other hazardous events would occur or how assets would be affected.
- As a result, NbS retrofitting has become a necessary and important tool in hazard mitigation.




Economic consequences  
(damage to infrastructure and  
recreational value of the coast)  
and environmental degradation.

# Coastal erosion and flooding – Mexican perspective

## *When is retrofitting necessary?*

- When the life span of a particular coastal protection system or structure is near its end
- When, upon diagnosis, the system in place no longer serves its purpose, due to sea level rise or changes in the prevailing conditions
- When there is structural failure due to poor design or extreme events
- Deterioration and aging
- As a preventive measure, to improve performance.

Scale of  
projects that  
increase  
coastal  
resilience  
through NbS  
retrofitting

- City-wide or regional coastal management strategies
  - National or internationally funded Ecosystem rehabilitation projects to increase coastal resilience through ecosystem services (cases described by Magarita Caso)
  - Private developments
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# Process of retrofitting

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Base line assessment: system's performance, financing, legal and permitting issues, and changes in risk levels

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Community engagement

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Retrofit action plan: selection and design of alternatives (cost-benefit analyses)

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Undertake retrofit works

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Maintenance and monitoring

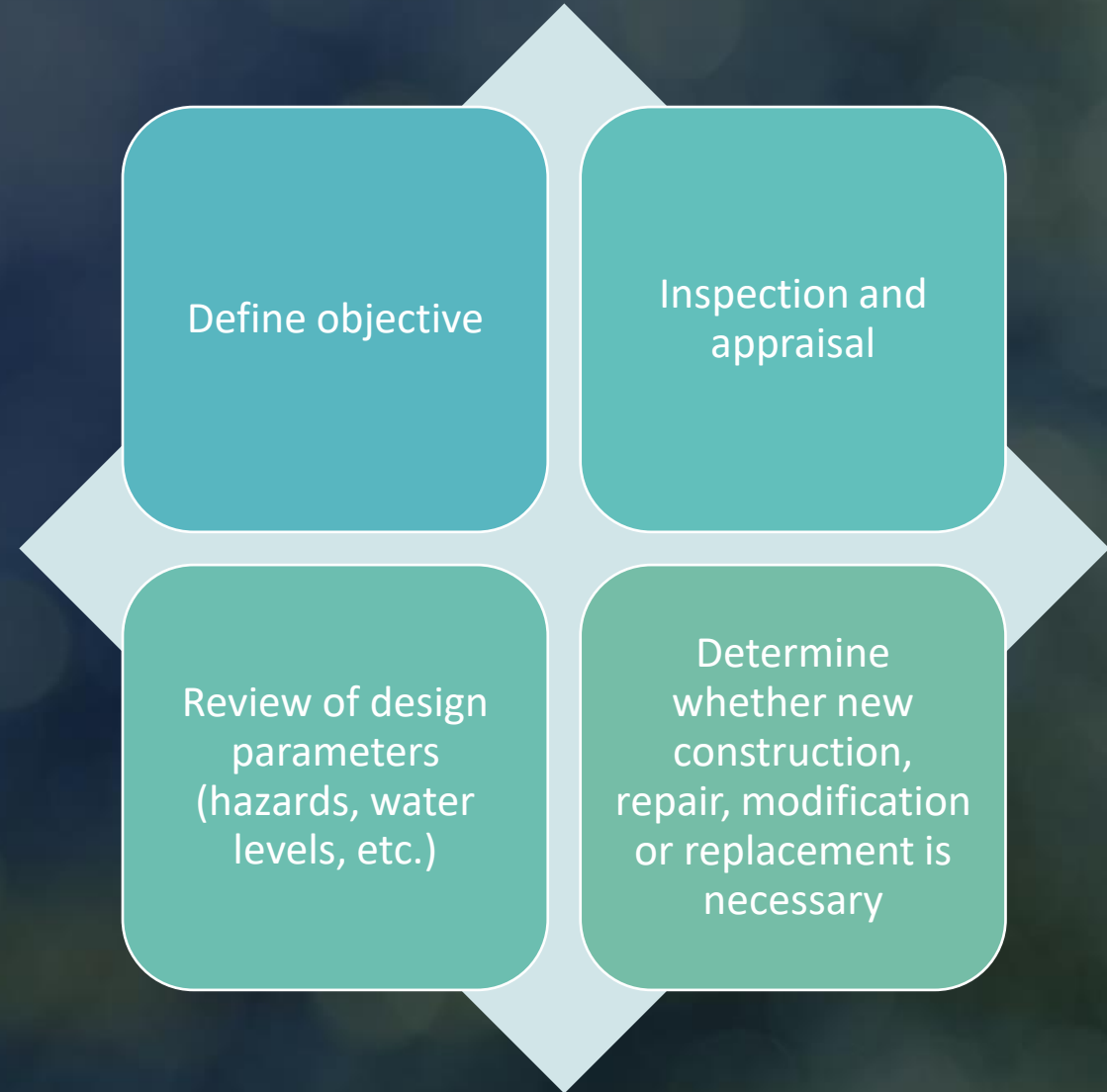
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Final assessment

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**Base line assessment**  
(current condition):  
Assessment of the  
actual condition of  
the coast and/or  
defense system in  
relation to the  
requirement.

It indicates whether the structure is  
satisfactory, or whether retrofitting is  
necessary





# At what stages can we perform NbS retrofitting?

New Construction	Repair	Modification	Replacement
<ul style="list-style-type: none"> <li>• No previous solution.</li> <li>• High risk (hazards and vulnerability).</li> </ul>	<ul style="list-style-type: none"> <li>• When there is structural failure due to poor design or extreme events</li> <li>• Deterioration and aging.</li> </ul>	<ul style="list-style-type: none"> <li>• As a preventive measure, to improve performance.</li> <li>• Due to sea level rise or changes in the prevailing conditions.</li> </ul>	<ul style="list-style-type: none"> <li>• When the life span of a particular coastal protection system or structure is near its end.</li> <li>• Illegal structure.</li> </ul>

# New Construction: Mayakoba tourist development

When there is no previous defense system and there is space, time and resources, a composite approach can be implemented.

13.15 km of canals were created to improve the hydrological flow of the deteriorated mangrove system and reduce flood risk.

It was complemented with dune conservation and restoration.

Most of the Infrastructure was located inland.

Some cobenefits were habitat creation and increase in recreation opportunities, such as bird watching, navigation, etc.



# Repair of existing defense system: Hondsbossche Dunes

The sea dike at that location no longer met Dutch flood safety standards.

Instead of raising and repairing the dike, an artificial beach and dune landscape was built on the seaside of the existing seawall.

An assessment with the Sustainable Asset Valuation (SAVi) methodology by the International Institute for Sustainable Development (IISD) showed that the Hondsbossche dunes outperformed conventional flood protection infrastructure.

In comparison to a grey infrastructure alternative of raising the sea dike, the nature-based infrastructure (NBI) was cheaper to build and brings greater benefits for tourism.

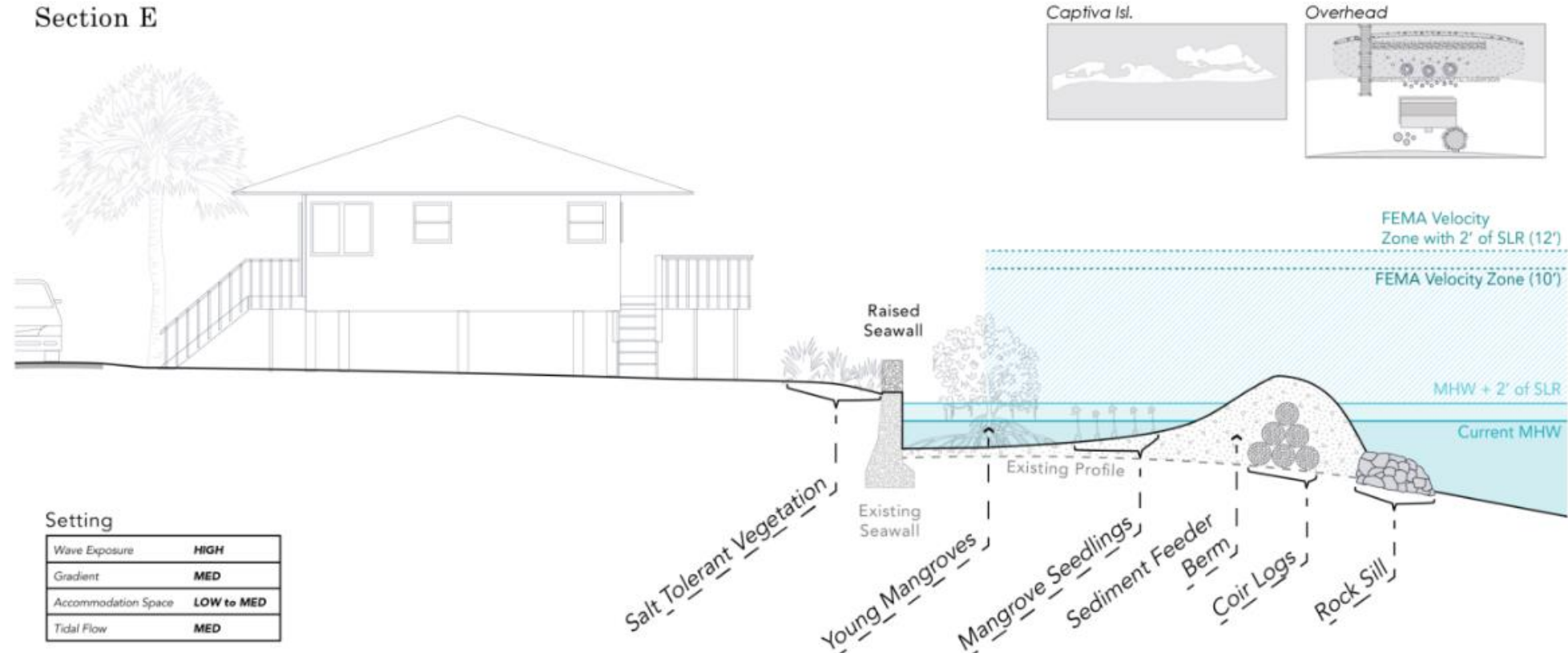
- Deterioration or aging
- Due to sea level rise or changes in the prevailing conditions



**Based on IISD's modelling, the sand dunes increase tourism revenue by almost EUR 203 million over 50 years, while the grey alternative would have increased it by only EUR 103 million.**

# Modification: Integral's conceptual strategies

- As a preventive measure, to improve performance.
- Due to sea level rise or changes in the prevailing conditions.
- Partner company, Integral Consultancy, proposed a variety of composite approaches consisting of a protective berm, mangroves and the existing seawall.
- Interconnected elements – elements work together for best success.



# Replacement of protection structures: Yucatan Coast

Illegal or badly planned groynes removed to allow for natural recovery of the beach.

Options of NbS are limited because restrictions regarding space and resources. There is no space for dune restoration, since infrastructure was built directly on top of dune system.

There is also a lack of government support in terms of resources or an integrated coastal management plan.

Based on these considerations, at some locations, artificial reefs have been introduced to dissipate wave energy and allow for accretion.



# LIMITATIONS TO RETROFITTING

- Areas with the higher risk receive more attention and funding, but they are also usually less apt for these types of solutions.
- Also, there is pressure to get results in less time and with “proven” traditional alternatives.
- This is a reactive approach that limits opportunities and the ability to set a precedent.

Time frame

Risk level

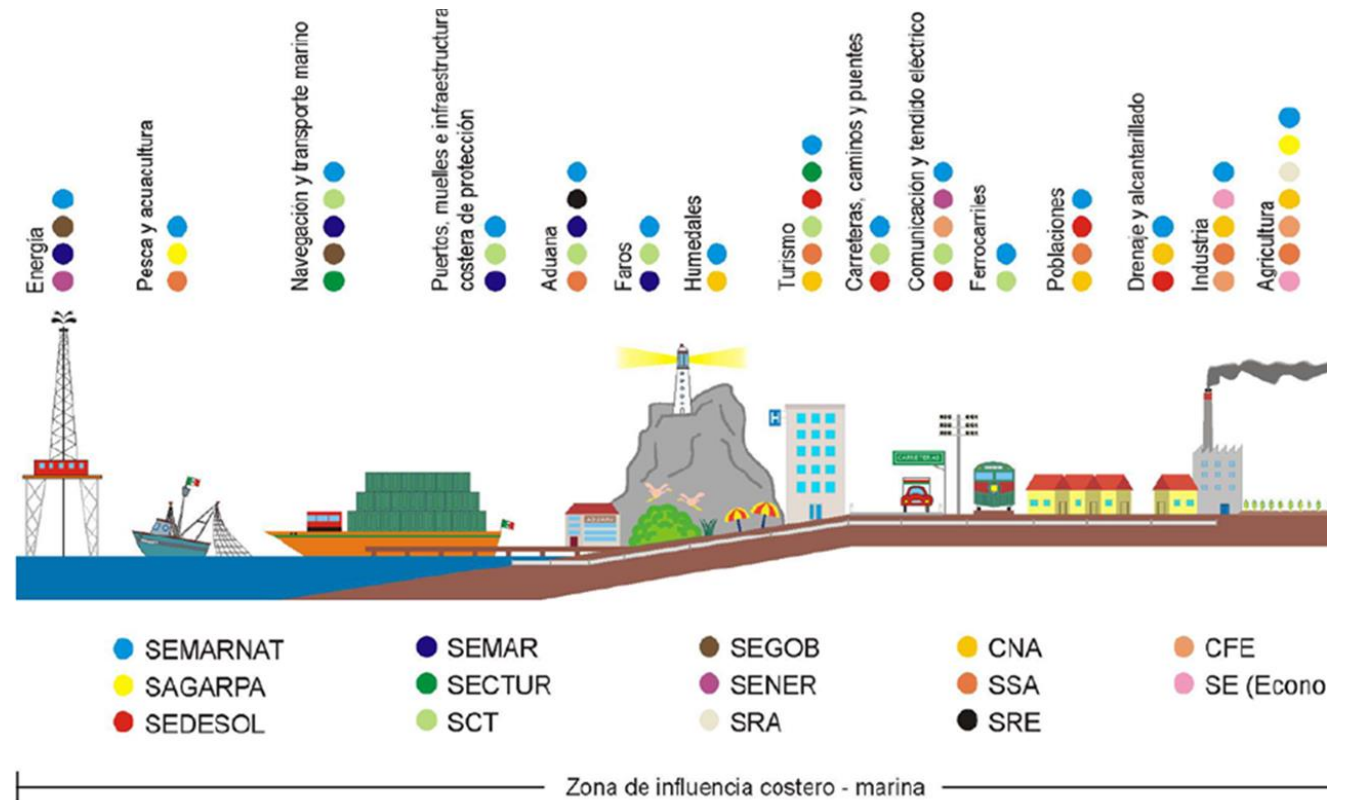
Available  
space

Funding

Precedent

# Key conclusions

- Very different perspectives for big developments and private homeowners, due to limitations in terms of time and resources.
- Need for a scalable evaluation framework and decision process to identify when and how to perform NbS retrofitting.
- Integrate the use of NbS into coastal management plans at a local level...very few successful examples.
- War forward lies in the communication of the benefits of NbS vs grey solutions (performance and economic).
- Key challenges are access to information and the complexity of administrative levels and number of institutions involved in the coastal zone in Mexico.



Thank you for your attention

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