ECOSYSTEM MODEL DIAGRAM – PELAGIC FOOD WEB STRUCTURE

1. Introduction

This annexure presents a conceptual **ecosystem food-web model** for the pelagic ecosystem of the Karnataka coast in the Arabian Sea. The model is based on the **Ecopath with Ecosim (EwE) ecosystem modelling framework**, widely used in fisheries ecosystem assessments.

The objective of this diagram is to illustrate:

- Energy transfer within the marine ecosystem
- The trophic role of small pelagic fish
- The ecological position of purse seine fisheries

This conceptual model is consistent with ecosystem modelling studies conducted for the **southwest coast of India and the Arabian Sea**.

2. Conceptual Food Web Diagram

You can insert this **diagram into Word using SmartArt or shapes**, or keep it as shown below.

3. Ecosystem Functional Groups

Trophic Level	Functional Group	Example Species
TL 5	Apex predators	Sharks, large tuna
TL 4	Large pelagic predators	Seerfish, barracuda
TL 3	Small pelagic fish	Sardine, mackerel, scads
TL 2	Primary consumers	Zooplankton
TL 1	Primary producers	Phytoplankton

4. Role of Small Pelagic Fish in the Ecosystem

Small pelagic fish represent a **critical trophic link** within marine ecosystems.

They perform three important ecological functions:

Energy Transfer: Convert plankton productivity into fish biomass that supports higher predators.

Prey Base: Provide food for:

- Tuna
- Seerfish
- Barracuda
- Dolphins
- Seabirds

Nutrient Cycling: Pelagic schooling fish contribute to nutrient redistribution within marine ecosystems.

5. Interaction with the Purse Seine Fishery

The purse seine fishery primarily interacts with **mid-trophic pelagic species**, which typically exhibit:

- High natural productivity
- Short life cycles
- Rapid population turnover

Because purse seines operate in the **mid-water column**, they generally have:

- Minimal benthic habitat impact
- Low discard rates
- High species selectivity

6. Ecosystem Considerations

The main ecosystem consideration associated with small pelagic fisheries globally is the **forage fish effect**, where excessive harvesting could affect predator populations.

However, ecosystem modelling studies in the Arabian Sea suggest that moderate exploitation of these species is unlikely to cause ecosystem collapse due to their **high productivity and recruitment variability**.

ECOSYSTEM RISK HEAT-MAP ASSESSMENT

1. Introduction

An **Ecosystem Risk Heat-Map** was developed to evaluate potential ecological impacts of the purse seine fishery on different ecosystem components.

The heat-map uses a **risk matrix approach**, combining:

- Likelihood of interaction
- Ecological consequence

This approach is widely used in fisheries ecosystem risk assessments and is consistent with **Productivity–Susceptibility Analysis (PSA)** and ecosystem-based management frameworks.

2. Risk Scoring Criteria

Score	Likelihood	Description
1	Low	Rare interaction
2	Medium	Occasional interaction
3	High	Frequent interaction
Score	**Consequence**	**Description**
1	Low	Minimal ecological impact
2	Medium	Moderate ecosystem impact
3	High	Significant ecosystem impact

3. Ecosystem Risk Matrix

Consequence ↓ / Likelihood →	Low	Medium	High
High			
Medium	Predator populations	Small pelagic prey availability	
Low	Habitat, seabirds, marine mammals		

4. Ecosystem Risk Heat-Map Table

Ecosystem Component	Likelihood	Consequence	Risk Level	Ecosystem Component
Small pelagic prey availability	Medium	Medium	Medium	Small pelagic prey availability
Predator populations	Low	Medium	Low	Predator populations
Marine mammals	Low	Low	Low	Marine mammals
Seabirds	Low	Low	Low	Seabirds
Non-target fish species	Low	Low	Low	Non-target fish species
Benthic habitats	Very Low	Low	Low	Benthic habitats
Plankton productivity	Very Low	Low	Low	Plankton productivity

5. Interpretation of Risk Heat-Map

The risk heat-map indicates:

- Most ecosystem components fall within the **low risk category**.
- The only moderate ecosystem consideration relates to **forage fish exploitation**, which requires continued monitoring.
- Habitat impacts are minimal because purse seine gear does **not contact the seabed**.

Overall, the fishery shows **low ecosystem risk**.

6. Conclusion

The Ecosystem Risk Heat-Map analysis supports the conclusion that the **Karnataka purse seine fishery does not present significant risks to marine ecosystem stability** under current management measures.

This analysis contributes to demonstrating compliance with **MarinTrust clauses E3.2 and E3.3**.

Scientific References

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