Science and Policy Integration for COastal System Assessment

SPICOSA

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TARTU ÜLIKOOL

SSA No 1

Improvement of management measures for the pikeperch stock in Pärnu Bay (Gulf of Riga)

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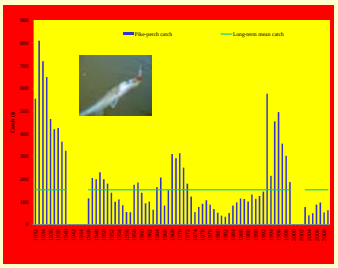
PROBLEM SCALING

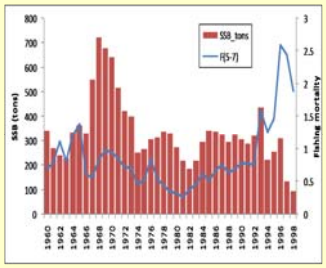
➢Pikeperch of Pärnu Bay is a valuable natural resource. It offers subsistence, engagement and income for coastal population and is a valuable export article. Pikeperch is a very important biomeliorator converting the biomass of inferior fish species into expensive pikeperch biomass. It endures moderate eutrophication.

➢During "open market" system it experienced extremly high fishing pressure, however natural conditions should favour forming abundant year-classes and increased stock biomass.

POLICY ISSUE "Interaction between fisheries managment & fish production"

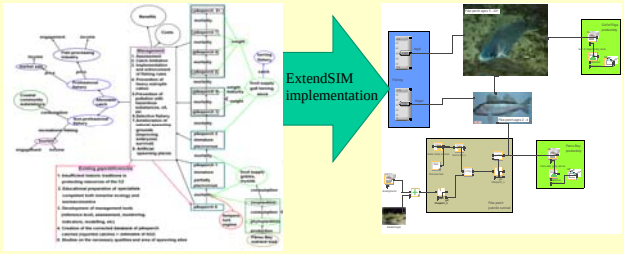


The catches have widely varied since 1932 showing lowest values during last decade



Because of high market price, in the 1990s fishing pressure on the stock, including immature fish, substantially increased and the stock fell into depression

PÄRNU BAY PIKE-PERCH – CONCEPTUAL MODEL



MODEL FORMULATION&POLICY-STAKEHOLDER INVOLVMENT

- Main model blocks:
  - Pike-perch juvenile survival
  - Immature piscivorous pike-perch (ages 2 – 4)
  - Mature pike-perch (ages 5 – 10+)
  - Parnu Bay productivity
  - Summer and winter temperature
  - Fishery
  - Climate change
- Step-wise refinement of model blocks
- User interaction via parameter database and slider utilities
- Model output storage in Extend databases
- Verification with pike-perch VPA output from 1970 - 1999

The stakeholder group formed met approximately twice per year and consisted of representatives from nine organizations ;

➢ Fisheries department of the Ministry of the Environment of Estonia,
➢Ministry of Agriculture of Estonia,
➢Environment Board and Environment Inspection of Pärnu county,
➢Estonian Marine Institute of the University of Tartu,
➢Organization of professional fishermen of the Pärnu county,
➢Union of the Gulf of Riga fishermen,
➢Fishery companies "Pärnu Bay" and "Japs".

➢ The consultations concluded, that exploitation of the pikeperch stock should be managed at exploitation rates corresponding to the maximum catch. The rates were identified based on the output of the used scenarios that were designed to indicate sustainable yields at different levels of fishing pressure, in harmony with the SAF applied.

We have selected a local fish stock, Pärnu Bay pike-perch, to demonstrate the interaction between eutrophication, fish production, management actions and climate change

Pärnu Bay pike-perch:

• a local non-migratory pike-perch stock

• economically most valuable species

• high fishing pressure, vulnerable due to its late maturity

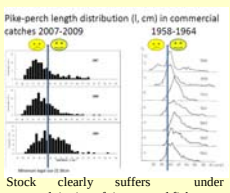
• experience with local quota and recruitment enhancment

• probably benefits from eutrophication via an increase in the Gulf of Riga productivity and the stocks of forage fish (herring)

• increased water temperatures in the Baltic Sea enhance survival of YoY

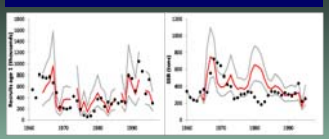
Year – class formulation & stock exploitation

$$\log\frac{N_t^i}{SSB_t} = a + b \cdot SSB_t + c \cdot \log(Goby_t) + s(Temp_t) + s(Ice_t)$$



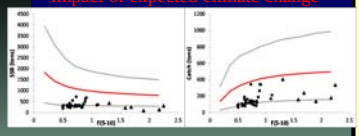
Stock clearly suffers under overexploitation of immatured fish

MODEL PERFORMANCE



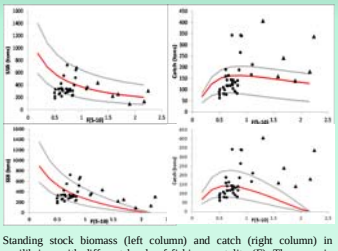
Number of recruits (left) and spawning stock biomass (right) simulated by the pikeperch virtual population model (lines: model results (red) with 5 % and 95 % percentiles (grey), dots: VPA estimates (Eero 2004)

Impact of expected climate change



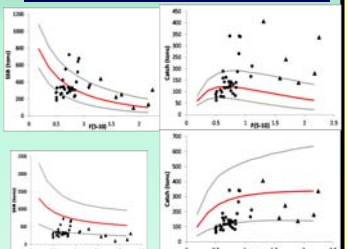
Standing stock biomass (left column) and catch (right column) in equilibrium with different levels of fishing mortality at "future" climate conditions. In accordance with the scenario the temperature was shifted by adding 1.5°C to the baseline temperature time series and the duration of ice cover was set to the observed minimum, or 67 days, to mimic the effects of global warming. The productivity part was left unchanged. Lines correspond to average (red) simulated SSB and catch, together with 5 % and 95 % percentiles (grey). Markers denote observed SSB and catches (Eero 2004) with no (circles) and significant (triangles) catch of immature fish.

Effect of harvesting immature fish



Standing stock biomass (left column) and catch (right column) in equilibrium with different levels of fishing mortality (F). The scenario for the top row assumes no catch of immature (1-4-year-old) fish with the length under 38 cm. The scenario for the bottom row presumes the F value for 3-year old fish 10% and for 4-year old fish 33%. In both cases the F value for the 5-year old and older fish is taken roughly equal to the F pattern in the period 1993-1998. Lines correspond to average (red) simulated SSB and catch, together with 5 % and 95 % percentiles (grey). Markers denote observed SSB and catches (Eero 2004) with no (circles) and significant (triangles) catch of immature fish.

Pikeperch stock dependence on Pärnu Bay productivity



Standing stock biomass (left column) and catch (right column) in equilibrium with different levels of fishing mortality, assuming low (top row, trawl index = 22) or high (bottom row, trawl index = 240) productivity expressed as Goby larvae abundance in Pärnu Bay. Lines correspond to average (red) simulated SSB and catch, together with 5 % and 95 % percentiles (grey). Markers denote observed SSB and catches (Eero 2004) with no (circles) and significant (triangles) catch of immature fish.