UNIVERSITY OF
EASTERN FINLAND

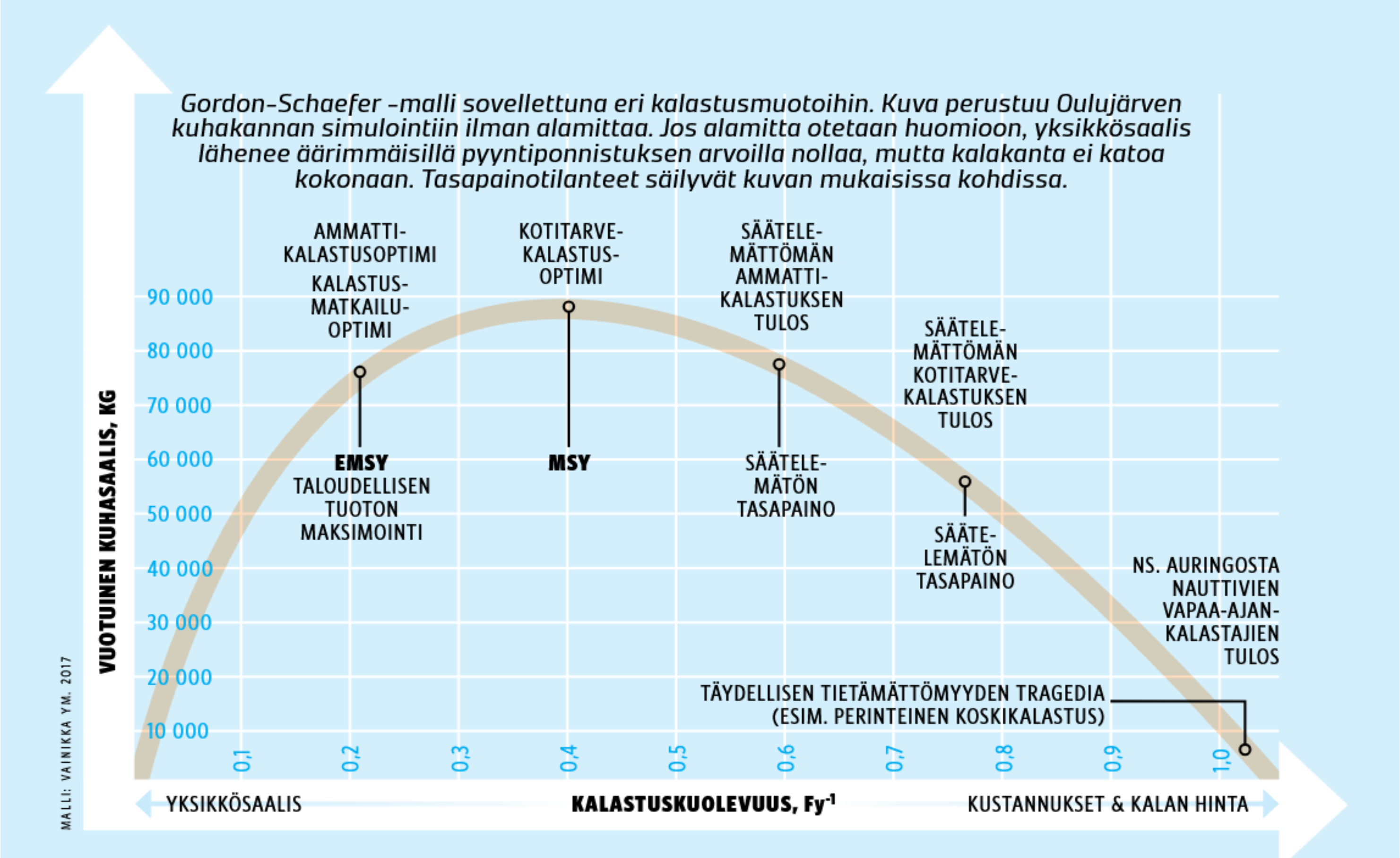
Populaatiomallinnuksella ymmärrystä ja indikaattoreita kuhakantojen kalastuksen säätelyyn

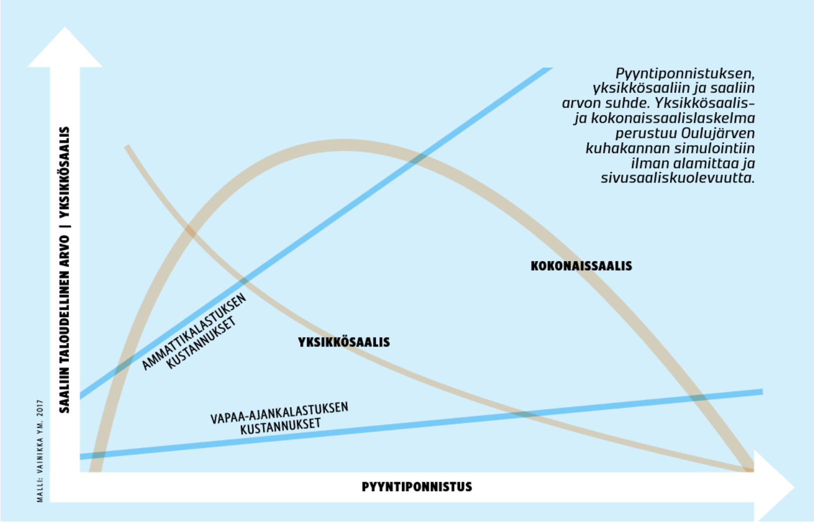
Anssi Vainikka, Hidaskasvuiset kuhakannat –seminaari
Lammi, 6.3.2025

Säätelyn strateginen tavoite

- Halutaanko mahdollisimman paljon saalisbiomassaa, laadukasta kuhan vapaa-ajan kalastusta vai terve ekosysteemi, jossa kuhat pitävät kurissa saaliskalakantoja?

Säätelyn strateginen tavoite



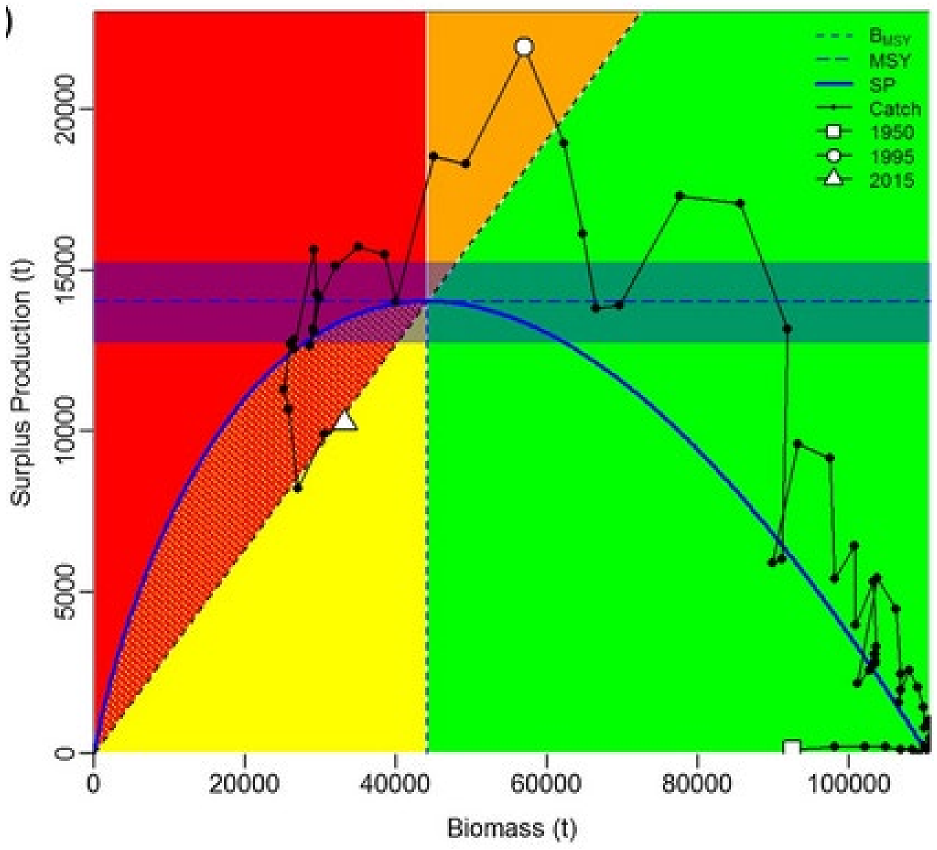


Tilannekuva on pimeä tai sumuinen

- Yleensä ei tiedetä, missä kohdin ”MSY-käppyrää” ollaan
- Keinoja tilanteen kirkastamiseen on
- Biomassapohjaiset menetelmät:

JABBA: Just Another Bayesian Biomass Assessment

Henning Winker [a b], Felipe Carvalho [c], Maia Kapur [c d]



Ikä-, pituus- ja sukukypsyysrakenteinen populaatiomalli

- Täysi pituusrakenteinen populaatiomalli (= simuloitu kalapopulaatio) on paras työkalu kalastuksen säätelyn tueksi, jos malli pystytään riittävän uskottavasti kalibroimaan tutkittavalle kalakannalle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Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Biomass and sustainable yields of Eurasian perch (*Perca fluviatilis*) in small boreal lakes with respect to lake properties and water quality

Anssi Vainikka [a,*], Aatu Turunen [a], Andrés Salgado-Ismodes [a], Eliisa Lotsari [b,1], Mikko Olin [c], Jukka Ruuhijärvi [c], Hannu Huuskonen [a], Céline Arzel [d], Petri Nummi [e], Kimmo K. Kahilainen [f]

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[b] Department of Geographical and Historical Studies, University of Eastern Finland, Joensuu, Finland
[c] Natural Resources Institute Finland, Helsinki, Finland
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[e] Department of Forest Sciences, University of Helsinki, Helsinki, Finland
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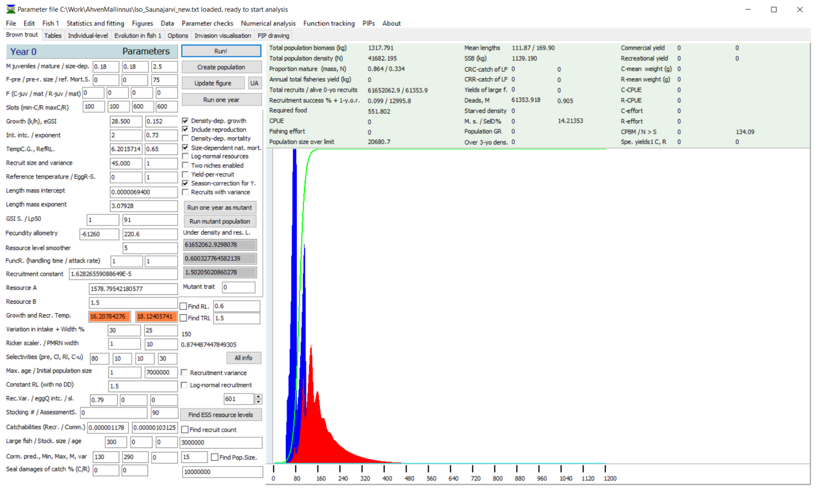

Mallinnuksen vaatimukset: 1) kasvu

- Von Bertalanffy, Lester, Boukal
- Edustavaa aineistoa kaloista, jotka eivät vielä ole valikoituneet kalastuksen takia
- 100 eri kokoista kalaa?
- Ikä tietyssä pituudessa
- Pituus tietyssä iässä (jos aidot satunnaisotokset)

ICES Journal of Marine Science

ICES CIEM International Council for the Exploration of the Sea / Conseil International pour l'Exploration de la Mer

ICES Journal of Marine Science (2019), 76(7), 2179–2192. doi:10.1093/icesjms/fsz107

Original Article

The Rosa Lee phenomenon and its consequences for fisheries advice on changes in fishing mortality or gear selectivity

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Kraak, S. B. M., Haase, S., Minto, C., and Santos, J. The Rosa Lee phenomenon and its consequences for fisheries advice on changes in fishing mortality or gear selectivity. – ICES Journal of Marine Science, 76: 2179–2192.

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When size-selective fishing removes faster-growing individuals at higher rates than slower-growing fish, the surviving populations will become dominated by slower-growing individuals. When this "Rosa Lee phenomenon" is ignored, bias may occur in catch and stock projections. In a length-and-age-based model we quantified the effects through simulations of a simplified fishery on a stock that resembles Western Baltic cod. We compared outcomes of runs with and without taking account of the Rosa Lee phenomenon in scenarios of changes in fishing mortality. We found that, when only fishing rate was changed, the biases in predictions of spawning-stock biomass (SSB), yield and catches of undersized fish were relatively small (<10% in absolute values). When the selectivity parameters of the gear were increased, the bias in the prediction of the catches of undersized fish was very substantial (+120 to 160%). When the selectivity parameters were decreased, the biases in the predictions of SSB, yield and catches of undersized fish, were substantial (25–50% in absolute values). With slower mean growth the biases became more pronounced. We conclude that in short-term forecasts, medium-term projections, and MSE simulations featuring selectivity changes, the Rosa Lee phenomenon should be accounted for, ideally by using length-based models.

Keywords: age–length-structured population model, demographic consequences, Rosa Lee phenomenon, selectivity changes, stock effects

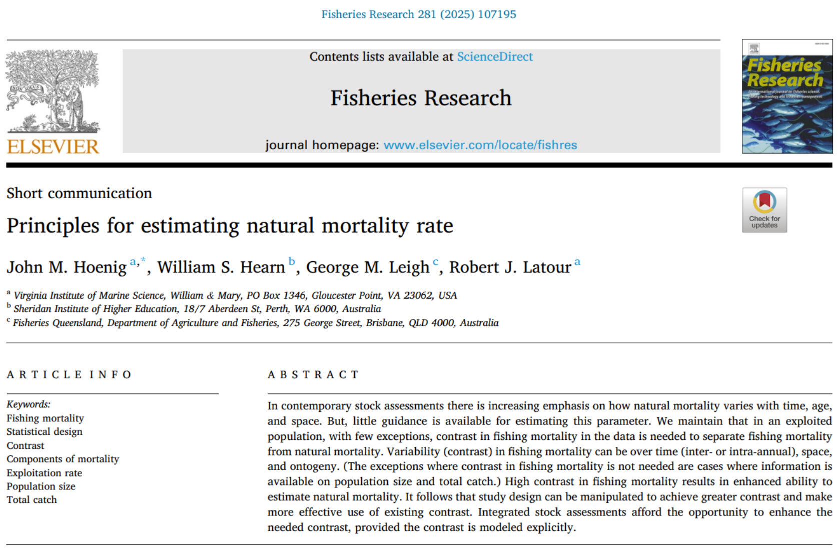
Mallinnuksen vaatimukset: 2) sukukypsyminen

- ELY:n poikkeuslupa alamittaisten pyyntiin
- Yksilöllistä aineistoa vähintään 100 eri kokoisesta kalasta ennen kutua
- Sukukypsyys, sukupuoli, pituus, paino
- Logistinen regressio, L50-arvo tai Lp50-arvon estimointi PMRN-menetelmällä. S-käyrän muoto.

	A	B	C	D	E	F	G
1	pond	species	age	length	mass	maturity	sex
2	aitalampi	ahven	6	156	37.5	1	1
3	aitalampi	ahven	6	185	56.5	1	2
4	aitalampi	ahven	5	141	25.5	1	1
5	aitalampi	ahven	6	153	34.5	1	1
6	aitalampi	ahven	5	159	43	1	1
7	aitalampi	ahven	6	162	41	1	2
8	aitalampi	ahven	2	122	20	0	0
9	aitalampi	ahven	2	123	21.5	1	1
10	aitalampi	ahven	3	134	24.5	1	2
11	aitalampi	ahven	2	115	15	1	2
12	aitalampi	ahven	3	130	21.5	0	0
13	aitalampi	ahven	2	112	14	1	2
14	aitalampi	ahven	3	134	23	1	2
15	aitalampi	ahven	7	170	47	1	1
16	aitalampi	ahven	7	179	51.5	1	2
17	aitalampi	ahven	4	130	21.5	1	2
18	aitalampi	ahven	6	156	36	1	2
19	aitalampi	ahven	2	121	17.5	1	1
20	aitalampi	ahven	5	169	42	1	2
21	aitalampi	ahven	1	116	16	0	0
22	aitalampi	ahven	2	114	14.5	1	1
23	aitalampi	ahven	0	79	5	0	0
24	aitalampi	ahven	2	116	16.5	1	2

Mallinnuksen vaatimukset: 3) kuolleisuus

- Luontaista kuolleisuutta voidaan arvioida istutustutkimusten ja esimerkiksi koeverkkokalastuksen kokojakaumien perusteella
- Kalastuskuolleisuus voidaan hakea mallin kalibroinnin avulla (kokojakaumien täsmäys)



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journal homepage: www.elsevier.com/locate/fishres

ELSEVIER

Short communication

Principles for estimating natural mortality rate

John M. Hoenig [a,*], William S. Hearn [b], George M. Leigh [c], Robert J. Latour [a]

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ARTICLE INFO

Keywords:
Fishing mortality
Statistical design
Contrast
Components of mortality
Exploitation rate
Population size
Total catch

ABSTRACT

In contemporary stock assessments there is increasing emphasis on how natural mortality varies with time, age, and space. But, little guidance is available for estimating this parameter. We maintain that in an exploited population, with few exceptions, contrast in fishing mortality in the data is needed to separate fishing mortality from natural mortality. Variability (contrast) in fishing mortality can be over time (inter- or intra-annual), space, and ontogeny. (The exceptions where contrast in fishing mortality is not needed are cases where information is available on population size and total catch.) High contrast in fishing mortality results in enhanced ability to estimate natural mortality. It follows that study design can be manipulated to achieve greater contrast and make more effective use of existing contrast. Integrated stock assessments afford the opportunity to enhance the needed contrast, provided the contrast is modeled explicitly.

Mallinnuksen vaatimukset: 4) rekrytoituminen

- Yksinkertaisimmillaan vakioluku, joka saadaan kalibroimalla malli niin, että se tuottaa tunnetut saaliit ja jota lasketaan, jos kanta tuottaa vähemmän mätimunia.
- Beverton-Holt, Ricker yms. jos dataa pitkältä ajalta ja eri kannan tasoilta.

Hydrobiologia (2019) 841:79–94
https://doi.org/10.1007/s10750-019-04008-z

Check for updates

PRIMARY RESEARCH PAPER

Effects of water temperature and pikeperch (*Sander lucioperca*) abundance on the stock–recruitment relationship of Eurasian perch (*Perca fluviatilis*) in the northern Baltic Sea

Eevi Kokkonen · Outi Heikinheimo · Zeynep Pekcan-Hekim · Anssi Vainikka

Received: 17 October 2018 / Revised: 22 May 2019 / Accepted: 22 June 2019 / Published online: 9 July 2019

Abstract How spawning stock size, environmental conditions and recruitment relate to each other is an essential question in understanding population dynamics of exploited fish stocks. We estimated the recruitment of Eurasian perch (*Perca fluviatilis*), one of the most important species in coastal fisheries in northern Baltic Sea, and examined the factors that determine perch recruitment success. We hypothesized that perch spawning population biomass and summer water temperature would increase perch recruitment, with potential density dependence, while the effect of the population size of pikeperch (*Sander lucioperca*) would be negative. Different forms of general stock–recruitment functions, with and without density dependence, and with and without water temperature and pikeperch population size as environmental factors were fitted to long-term (1981–2014) stock assessment data of perch and pikeperch in the Archipelago Sea, southwestern coast of Finland. Perch spawning stock biomass (ages 5–14), water temperature in June–July and pikeperch stock size (ages $\geq$ 1) at spawning year best explained variation in perch recruitment. The results supported the predictions: perch recruitment increased with spawning stock in density-dependent manner, pikeperch effect on perch recruitment was negative and summer temperature effect was positive suggesting environmentally affected competitive interaction between these two percids.

Mallinnuksen vaatimukset: 5) resurssidynamiikka

- Kalojen kasvu on tiheydestä riippuvaa ja vaihtelee yksilöllisesti
- Jos tämä halutaan ottaa huomioon, näin voidaan toimia.
- Arvio kalojen käyttämän ravinnon määrästä.
- Toiminnallinen vaste (usein II)

Transactions of the American Fisheries Society 137:1741–1755, 2008

DOI: 10.1577/T07-113.1

[Article]

A Bioenergetics Model for Zander: Construction, Validation, and Evaluation of Uncertainty Caused by Multiple Input Parameters

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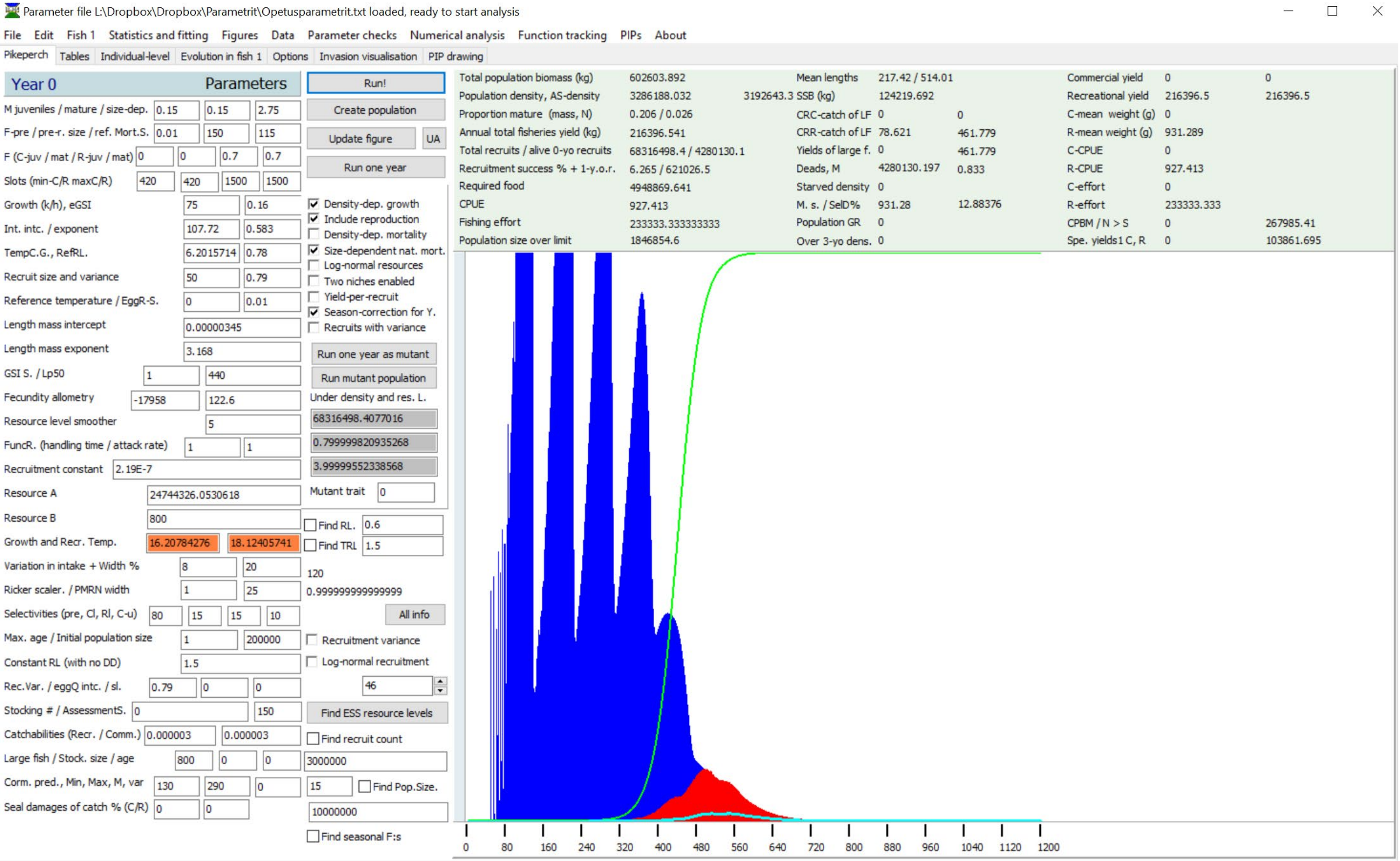
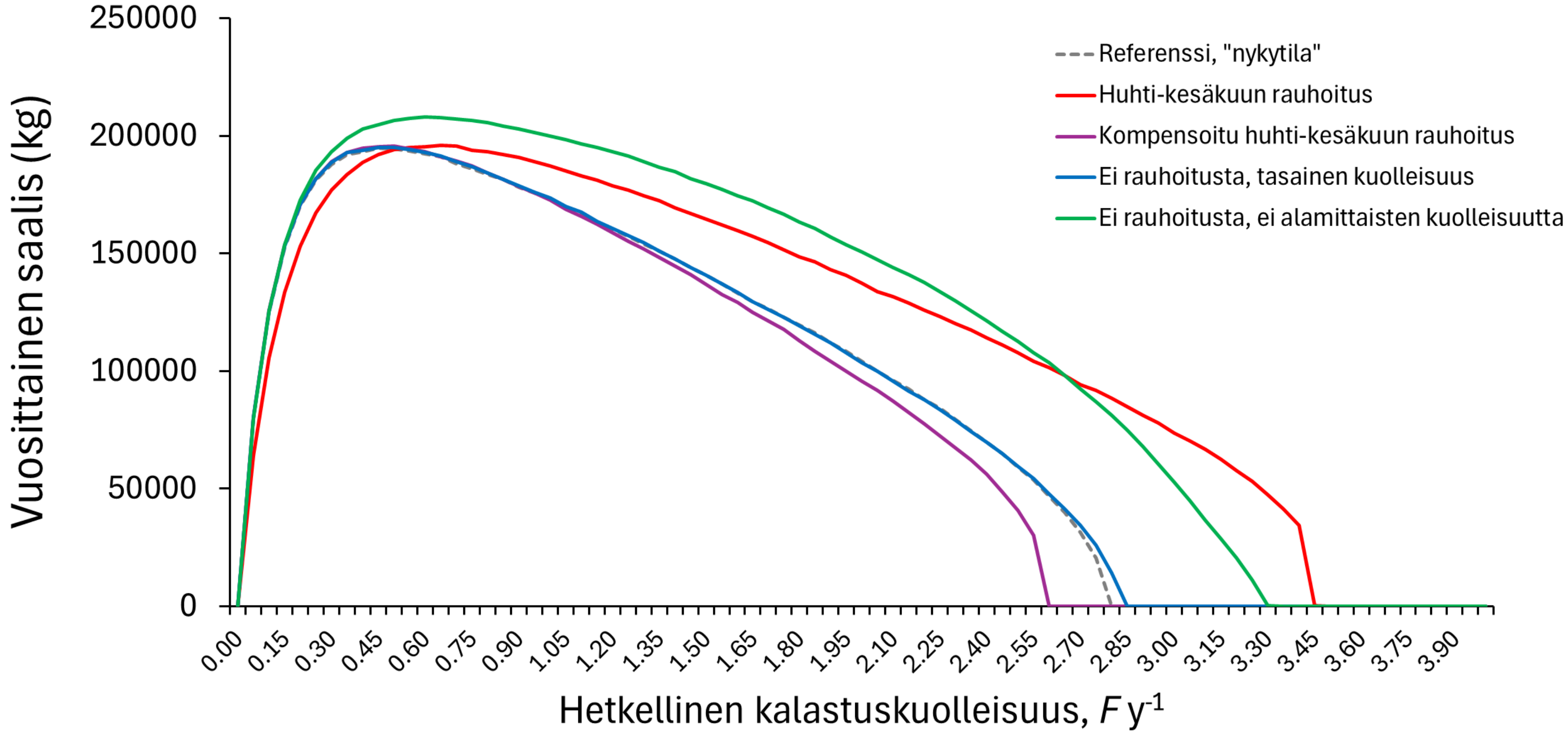
Abstract.—A bioenergetics model for zander *Sander lucioperca* was constructed using data from respirometer and feeding experiments to estimate temperature and mass-specific functions of metabolic and food consumption (*C*) rates. Other parameters were taken from the literature. The model, together with a previously published model for walleyes *S. vitreus* (Kitchell et al. 1977) and its modification for zander (Salonen et al. 1996), was validated with independent feeding experiments in the laboratory and was field evaluated in two lakes by using mercury (Hg) as a marker. Both validation procedures gave high modeling efficiency, indicating that the model was able to predict zander *C* under field conditions. The effect of uncertainty in 29 input parameters on Hg concentration and *C* was estimated using the Latin hybercube sampling technique (a modified Monte Carlo approach that uses a form of stratified sampling). The simulation results showed that our model was rather insensitive to given uncertainties in input parameters. Parameters in respiration function were responsible for producing the highest uncertainty for *C*. Parameters in Hg balance model produced the highest uncertainty for Hg concentration. Furthermore, both output variables were sensitive to the activity multiplier, which supported earlier results on the central role of activity in bioenergetics models. The field test of our model with different growth rates and Hg concentrations indicated that in the long term, our experimentally measured routine metabolic rate satisfactorily described the activity of fish in the field. The original walleye model and its revision for zander underestimated zander *C* relative to the bioenergetics model developed here. Our new model offers a validated tool for estimating *C* and trophic impact of the zander population.

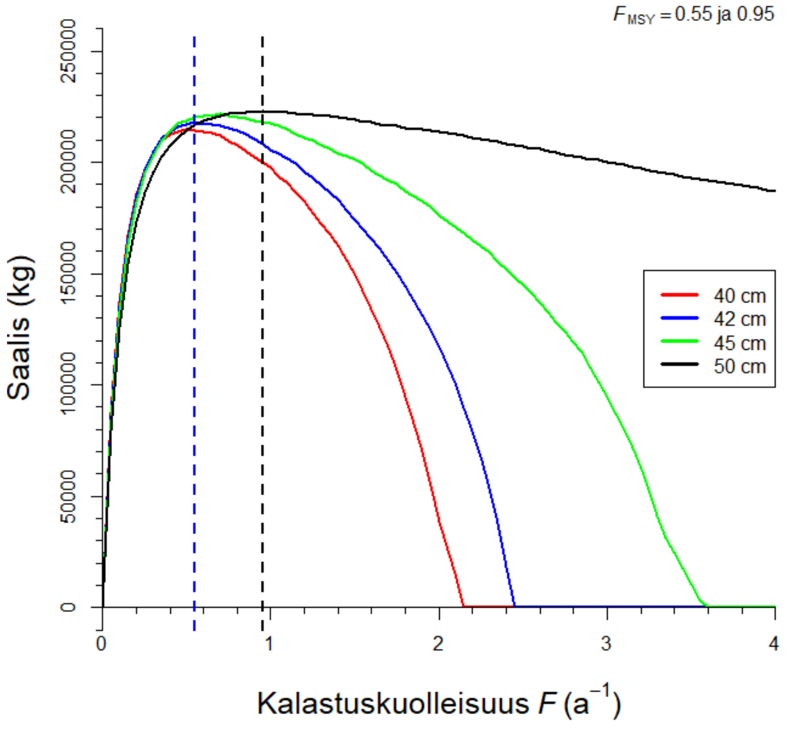
Mallinnuksen vaatimukset: 6) asiantuntemus: simuloitu kalakanta vastaa järvessä havaittua

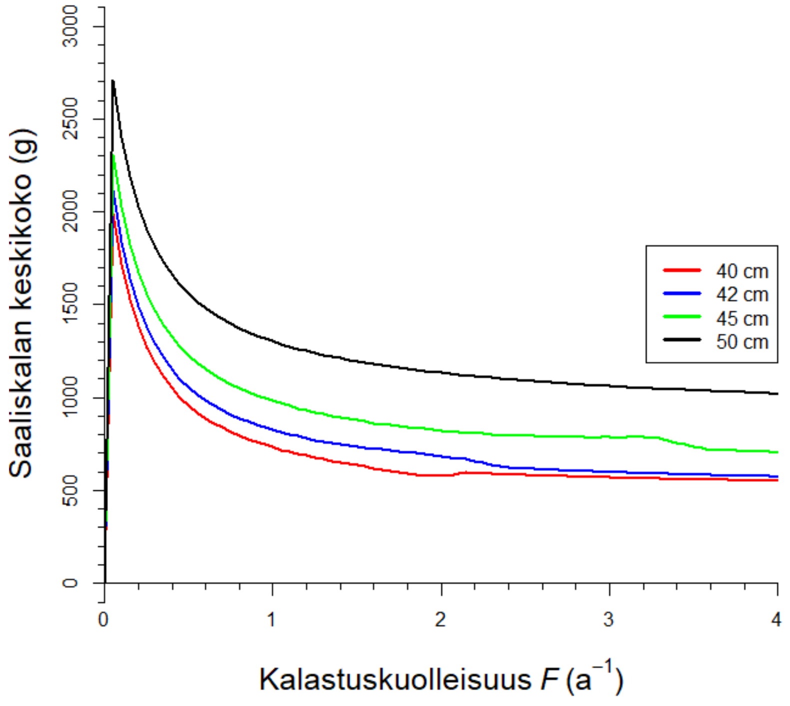


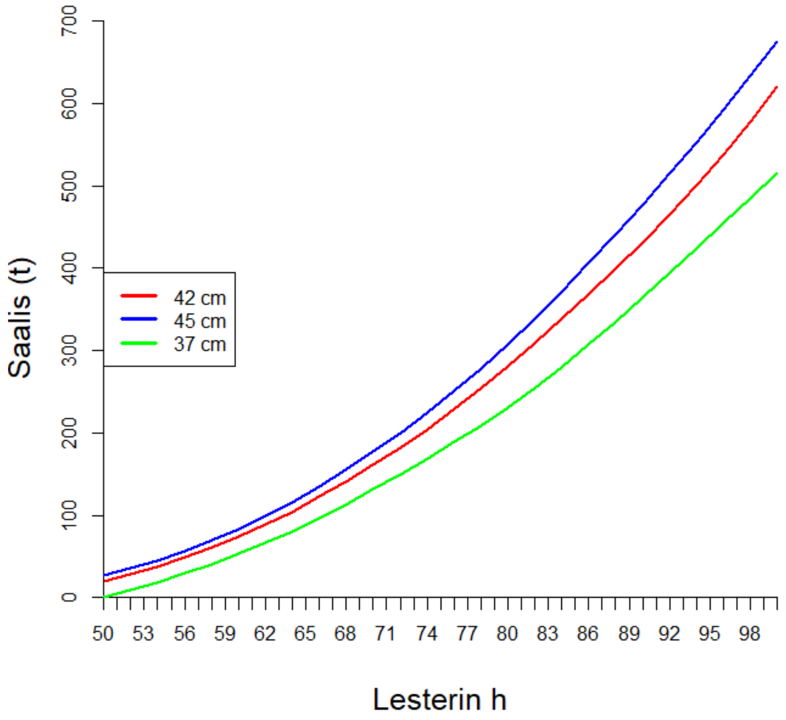
Mahdolliset käyttötarkoitukset: 1) Saaliin arviointi eri skenaarioissa



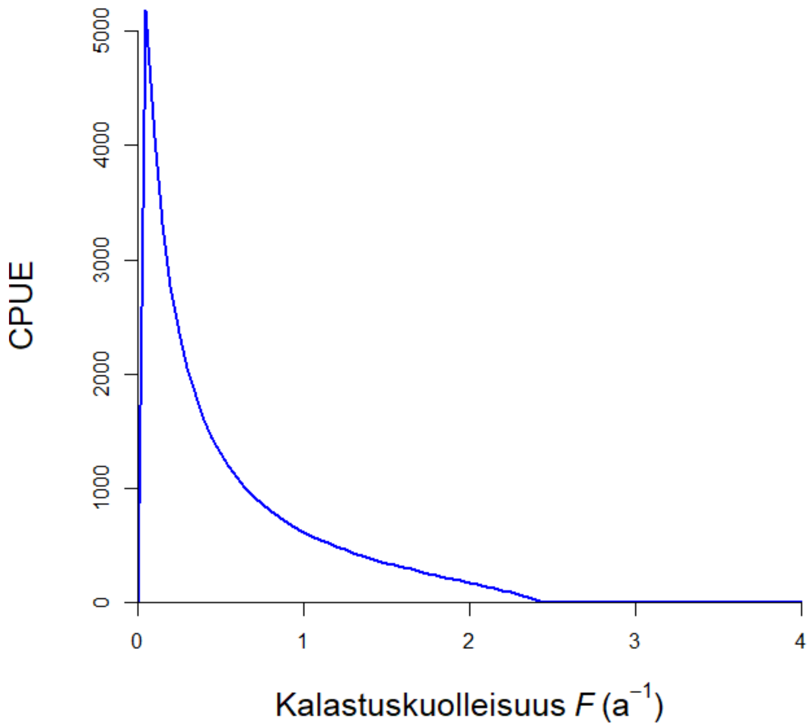
Mahdolliset käyttötarkoitukset: 2) Alamittavaihtoehtojen punninta

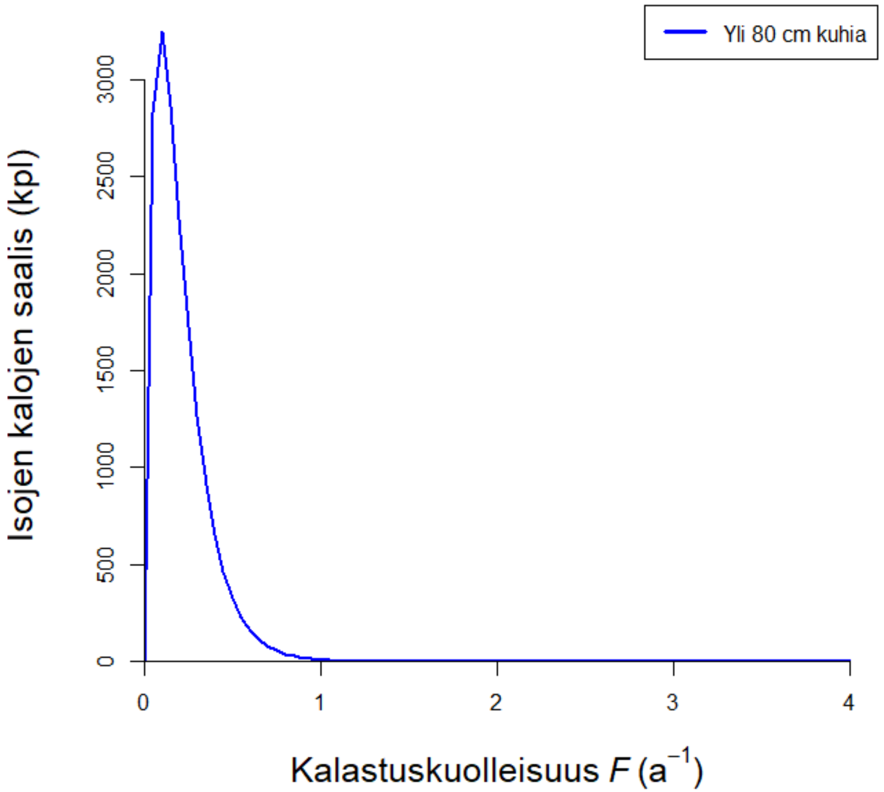






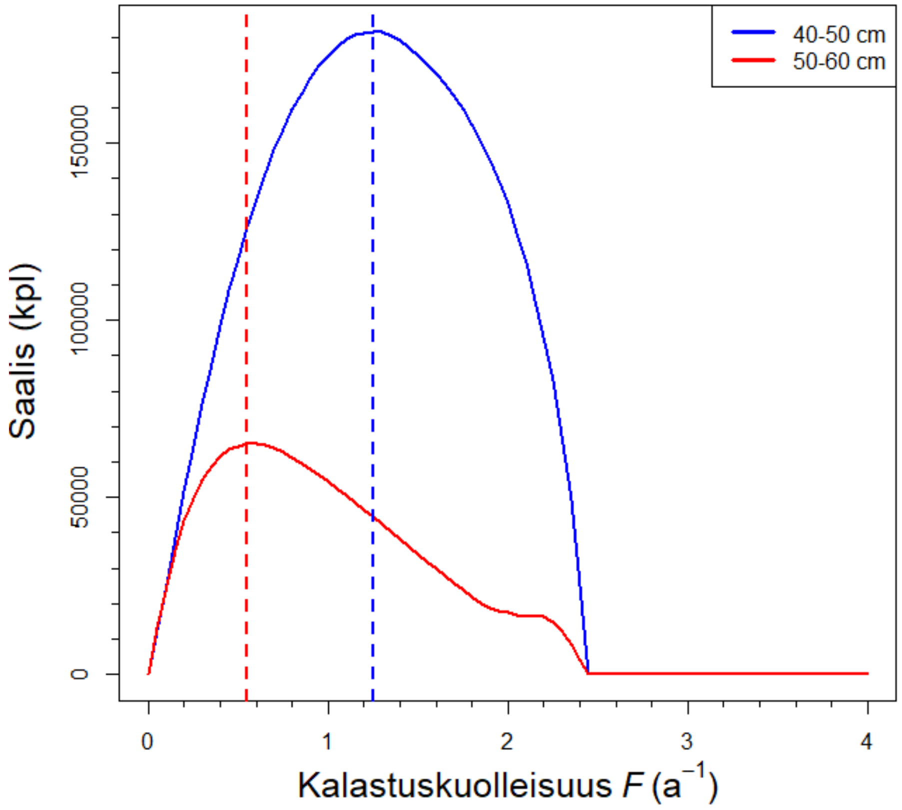
Mahdolliset käyttötarkoitukset: 3) Yksikkö-/erikoissaaliin arviointi





Mahdolliset käyttötarkoitukset: 4) Kestävyysindikaattoreiden luonti

- Referenssit saaliin kokoluokkien suhteille
- Referenssit rekryyttien / jokipoikasten / smolttien / kutukalojen määrälle
- Kiintiöiden määrittely



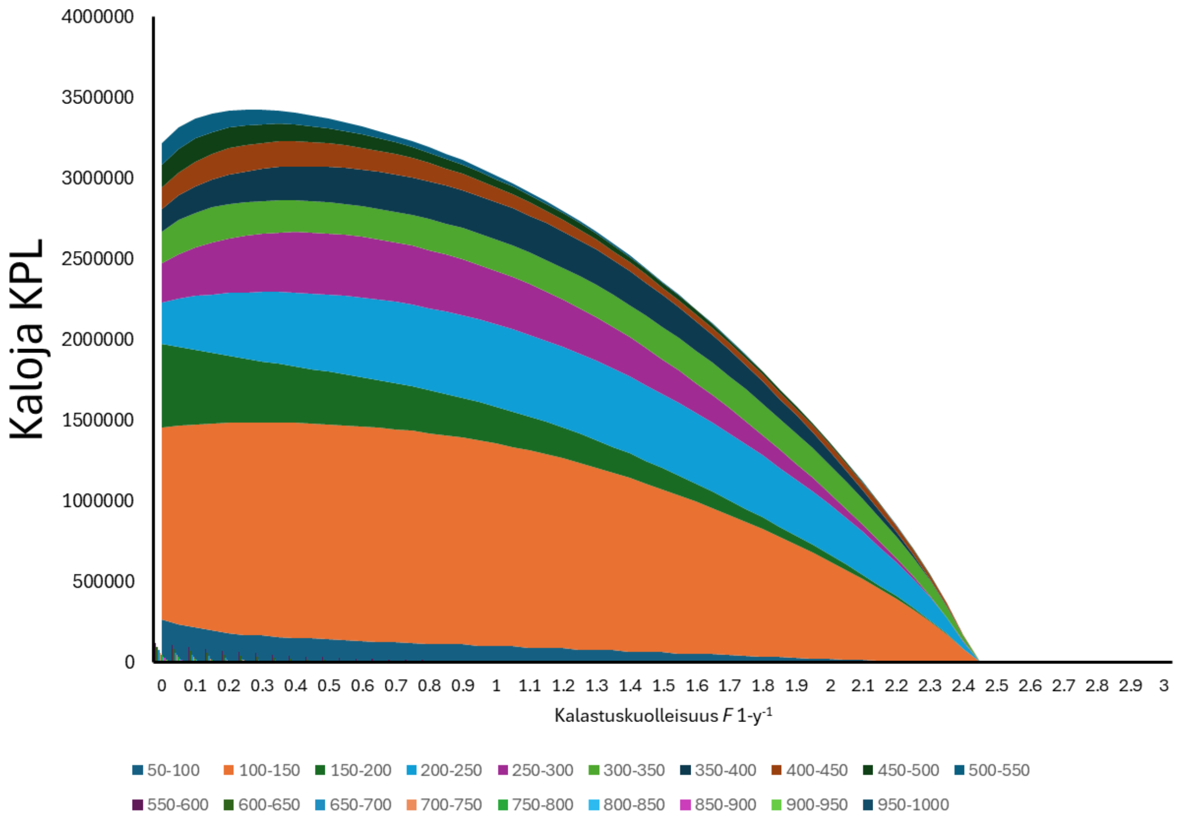
Lisäksi voidaan arvioida

- Evolutiivisia vaikutuksia
- Ympäristön muutosten vaikutuksia
- Riskiarvioita ja todennäköisyyksiä
- Säätelyn muutosten lyhytaikaisia vaikutuksia
- Monia biologisia ominaisuuksia
- Omaa ymmärrystä kalapopulaatiodynamiikasta

Adobe Firefly

Johtopäätökset

- “All Models Are Wrong, Some Are Useful” - George Box 1976
- Malli toimii yhtä hyvin sen pohjana olevat datat edustavat todellisuutta
- Mallilla on turvallisempaa testata säätelyvaihtoehtoja kuin oikealla kalakannalla
- Jos jokin asia ei toimi edes teoriassa, se ei varmasti toimi käytännössä
- Jos jokin asia toimii teoriassa, se ei välttämättä toimi käytännössä



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