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RISK INDEX FOR EBFM

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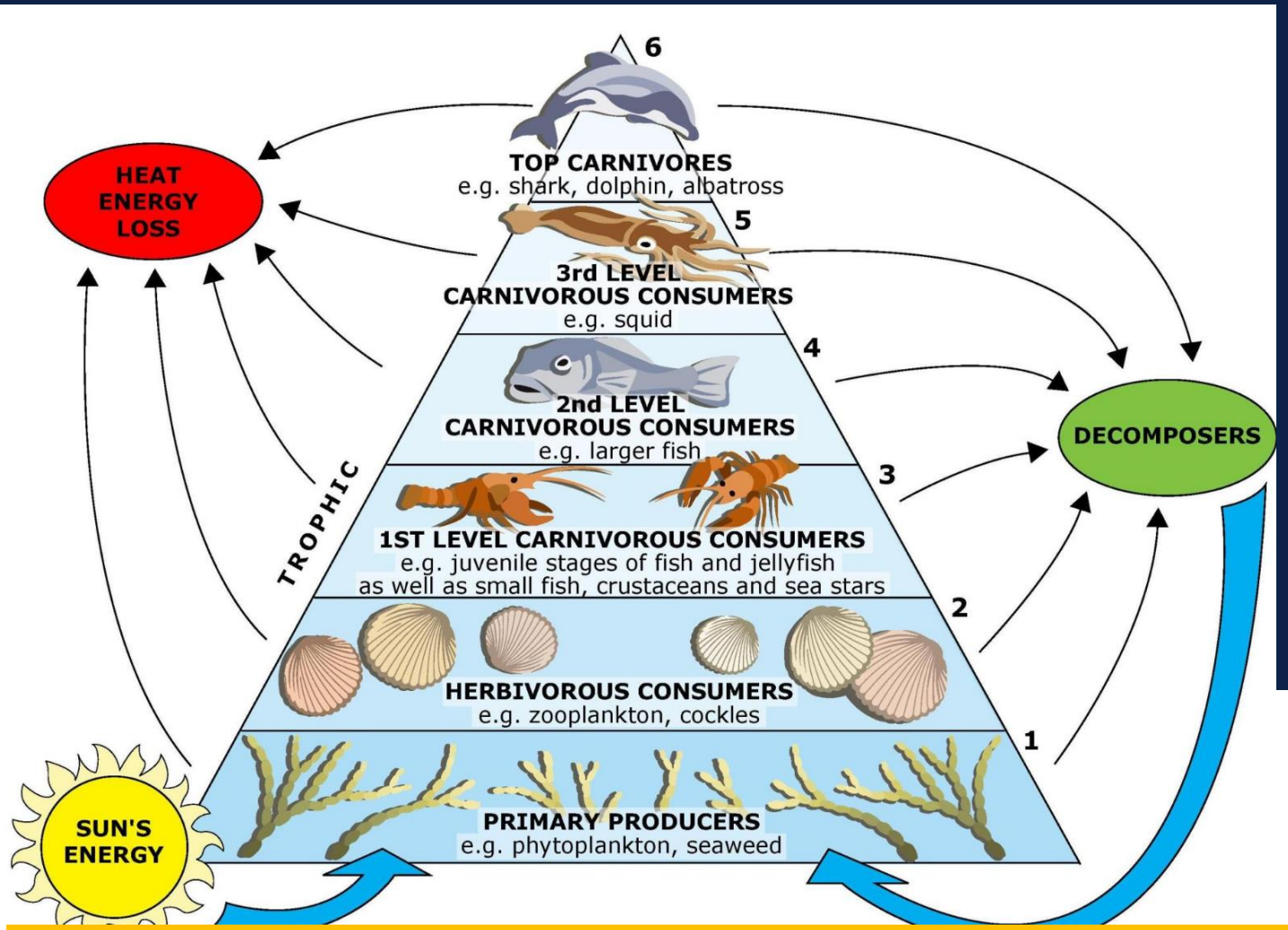

EBFM involves consideration of the impacts of fishing on the whole ecosystem, and treats the fish community holistically.

What happens when we consider multiple stocks together as an integrated management target?

HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? SINGLE=SPECIES PERSPECTIVE

Traditionally we consider each stock independently

- Each stock is individually modelled
- Boundary conditions may come from an EM or multispecies model, e.g. SMS
- Each stock must individually be precautionary < 5% chance of SSB < BLIM
- BLIMs are set stock by stock over different time-periods, so may or may not be an internally consistent set.

Total risk = sum of the individual stock risks

- Each stock must have < 5% chance of SSB < BLIM

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HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? MULTISPECIES PERSPECTIVE??

A single risk measure for the whole community taken together

- Stocks modelled/managed together
- The overall space must be precautionary
- Naïve approach is to say “ONE out, ALL out.

BUT – Management space tends to shrink with number of stocks if *every* stock is simultaneously required to be precautionary

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HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? MULTISPECIES PERSPECTIVE??

A single risk measure for the whole community taken together

- Stocks modelled/managed together
- The overall space must be precautionary
- What about allowing 5% of the total risk space?

BUT – Now the risk against any one stock can rise dramatically as the number of stocks goes up

As the number of stocks increases, management options are preserved, but we may permit highly depleted stocks.

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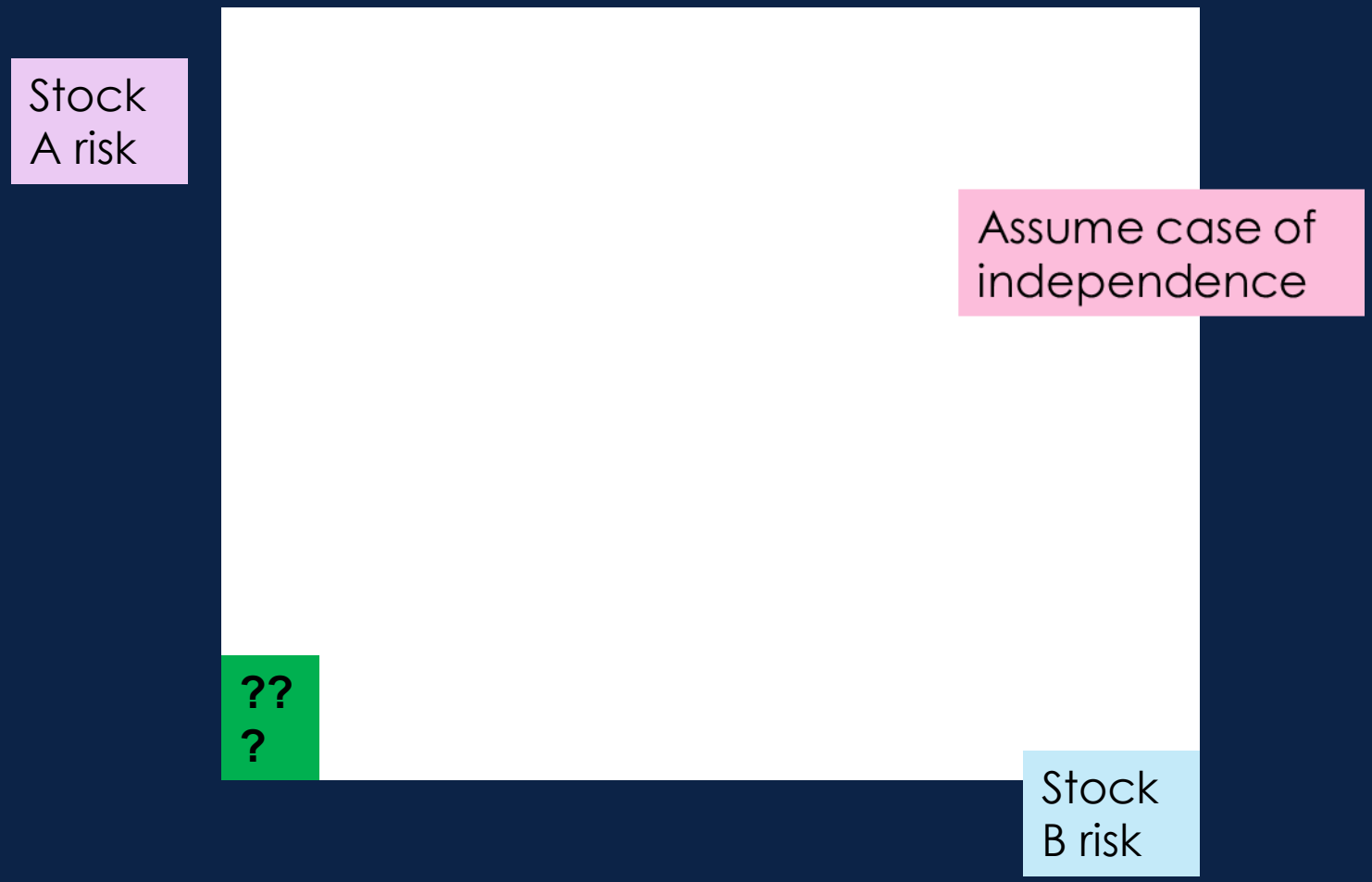
HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? MULTISPECIES PERSPECTIVE??

A single risk measure for the whole community taken together

- Stocks modelled/managed together
- The overall space must be precautionary

We need a risk measure which can prevent dangerous depletion whilst allowing management flexibility



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HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? MULTISPECIES PERSPECTIVE??

We need a risk measure which can prevent dangerous depletion whilst allowing management flexibility

Each stock has equal value to the index.

Rate of change of risk is proportional to 1/biomass

Each halving of biomass from unfished doubles stock risk sensitivity.

RR = 0 unfished

RR < 1 = acceptable

RR > 1 unacceptable

RR = inf – at least one stock extinct

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OPINION | Free Access

Emerging issues in fisheries science by fisheries scientists

David S. Murray, Victoria Campón-Linares, Carl M. O'Brien, Robert B. Thorpe, Rui P. Vieira, Fiona Gilmour

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Abstract

The current epoch in fisheries science has been driven by continual advances in laboratory techniques and increasingly sophisticated approaches to analysing datasets. We now have the scientific knowledge and tools to proactively identify obstacles to the

Relative Risk of Depletion (RR)

Risk is
a) relative to the unfished state
b) Relative to societal tolerance of depletion

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HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? MULTISPECIES PERSPECTIVE??

$$dR/dB = -K/B$$

To get the RR for the community, take the mean of the log of the depletions relative to B0.

The maximum allowed B/B0 is 1, no bonus for being above this level.

Then divide by the log of the biomass depletion that is at the limit of acceptability.

RR = 0 unfished

RR < 1 = acceptable

RR > 1 unacceptable

RR = inf – at least one stock extinct

$$R = -K \ln(B) + C$$

$$R = 0 \text{ when } B = B0 :: C = K \ln(B0)$$

$$R = -K \ln(B/B0)$$

If BREF is the limit of acceptable risk, we can set $1 - K = \ln(BREF/B0)$

$$RRx = \text{mean}(\log(Bx/B0))/\log(BREF)$$

where BREF is a fraction of B0 which sets society's risk tolerance

HOW DO WE DETERMINE THE OVERALL RISK TO A FISH COMMUNITY? MULTISPECIES PERSPECTIVE??

$$dR/dB = -K/B$$

Stock 1	Stock 2	Stock 3	MEAN	RR (BREF = 0.6)
0.9	0.7	0.6	0.73	0.63
0.9	0.5	0.6	0.67	0.85
0.9	0.5	0.4	0.60	1.12
0.6	0.6	0.6	0.60	1.00
0.9	0.9	0.2	0.67	1.19

The maximum allowed B/B0 is 1, no bonus for being above this level.

Then divide by the log of the biomass depletion that is at the limit of acceptability.

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THE EU COMMON FISHERIES POLICY : INTEGRATION OF RISK

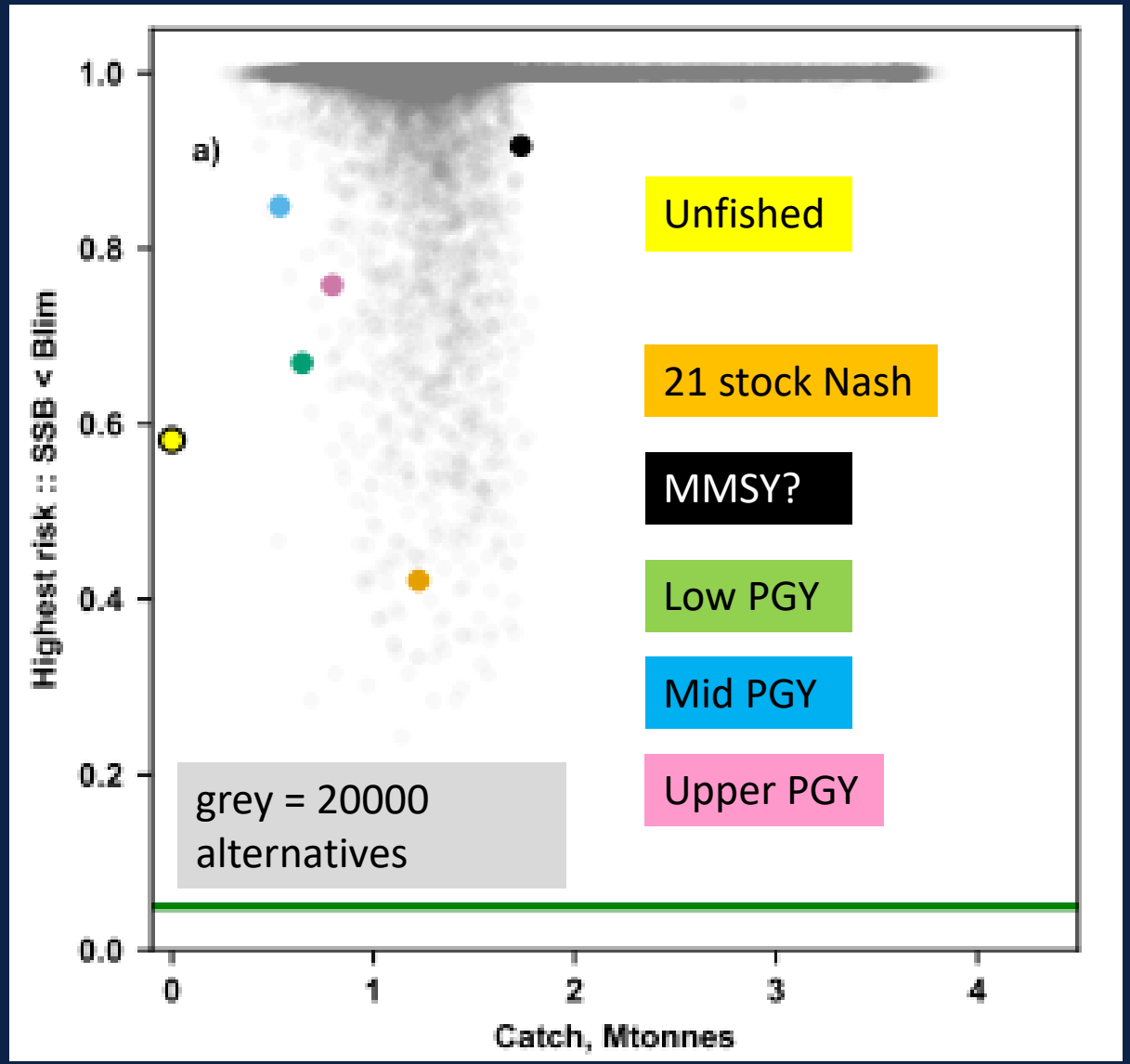
Key Issues

There is no precautionary space when the set of 9 North Sea Blims are considered together

There is no precautionary yield space – even no fishing is not precautionary!

B cannot be above Bpa for all stocks at the same time under any fishing strategy

Blims are incommensurate – relate to different time periods and do not fully take into account stock interactions



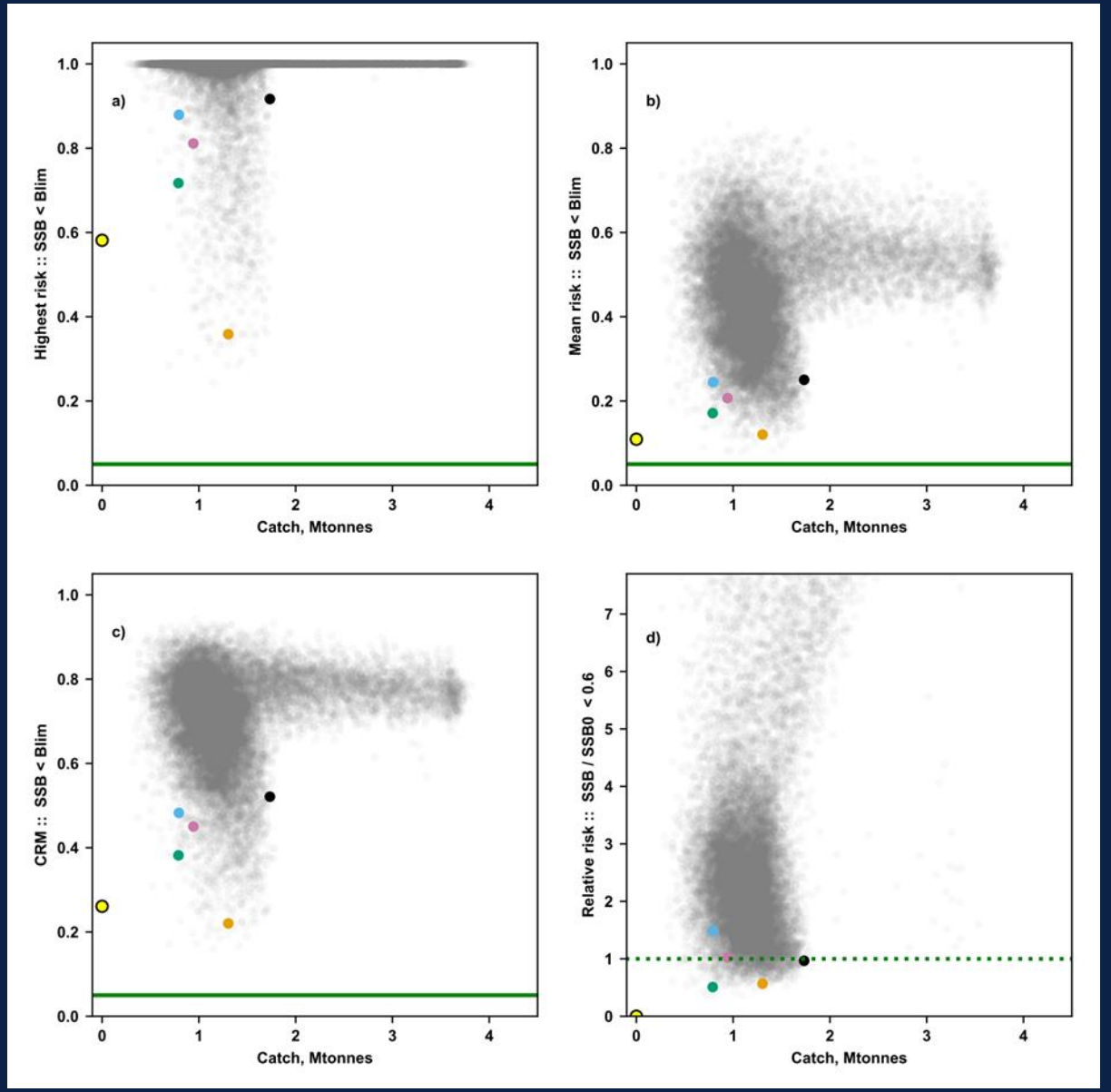
Results from app based on Spence and Kerr, ensemble estimate of MMSY using 4 north sea models

INTEGRATION OF RISK

Single species basis	Multispecies basis
a) Worst risk B < Blim less than 0.60	c) Thorpe/DeOliveira community risk metric of depletion below Blim < 0.4 with risk tolerance of 1.
b) Mean risk B < Blim less than 0.25	d) Relative risk of depletion below 40% virgin biomass < 1

3 risk metrics use Blim

1 uses virgin biomass



Risk levels chosen to include unfished and reasonable fraction of F-space

Risk levels much higher than formally acknowledged by ICES because of the inclusion of structural uncertainty

SUMMARY

Moving to EBFM is facilitated by a single risk metric to summarise the community state.

Integrating risk is problematic because neither averaging nor one-out-all-out works when there are lots of stocks.

We propose a novel risk index and apply it to 4 models and 19684 simulations in the Spence and Kerr app.

There is a cleaner relationship between the risk metric and Spence/Kerr outcomes than for other metrics.

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