Advancing length-only stock assessment applications and unifying data-limited stock assessment modelling using Stock Synthesis

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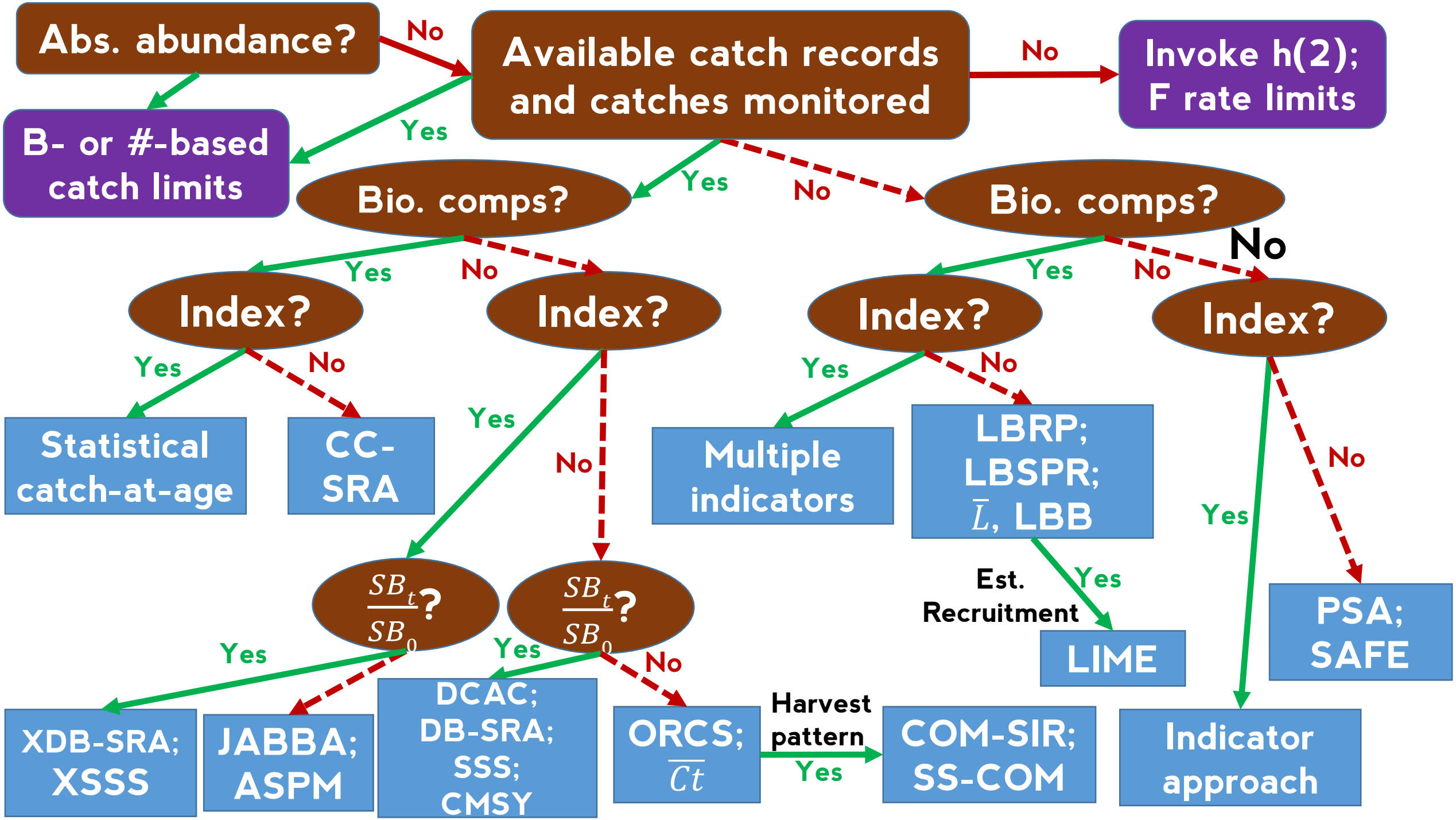
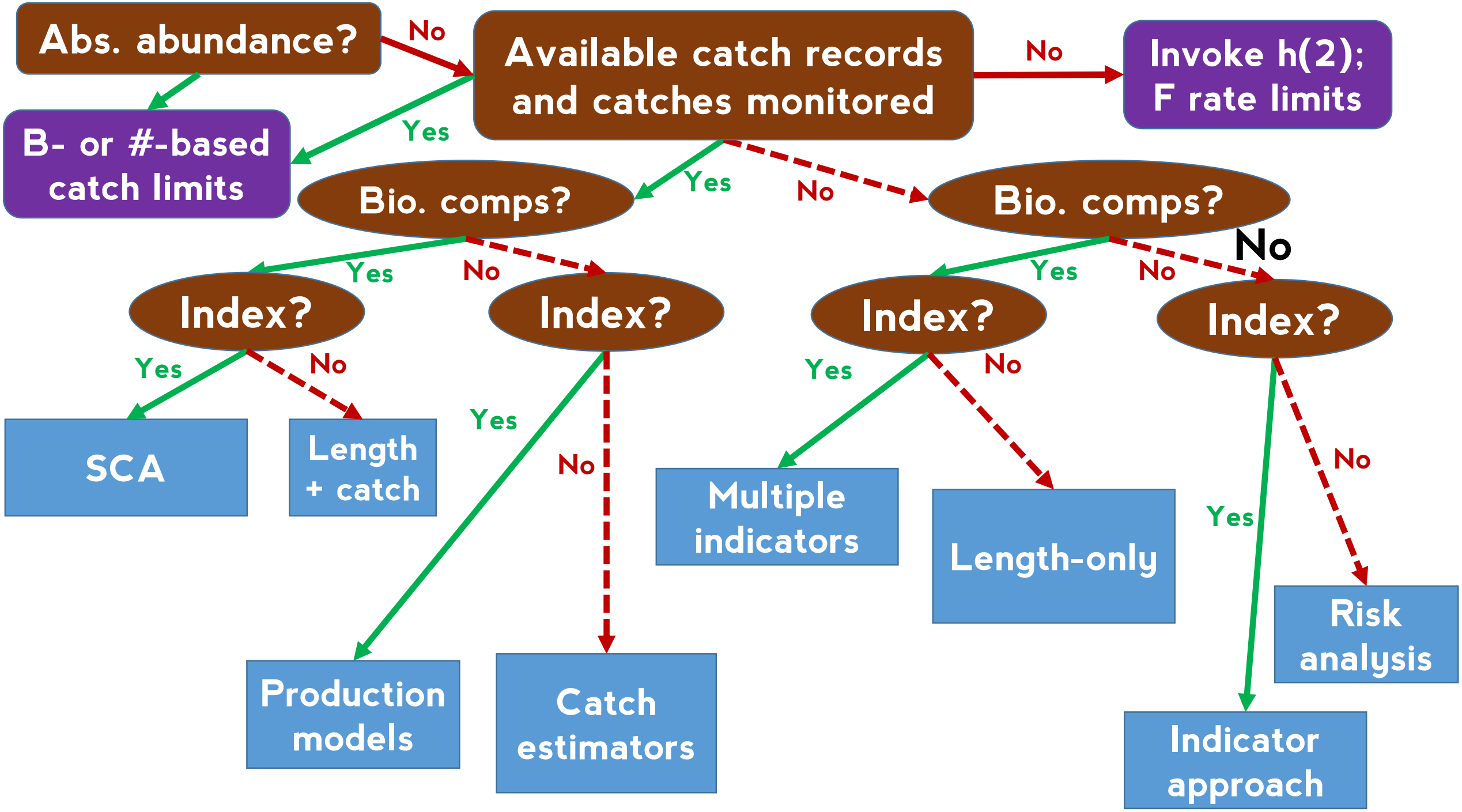
Data-limited applications

Method	Data	Output
Length-only (LBSPR;LIME)	Length compositions	Stock status: F
Indicator method	Abundance index	Catch or F
Multiple indicator	Length composition + abundance index	Catch or F
Catch-only (CMSY; DCAC, DBSRA; SSS)	Catch history	Catch
Extended catch-only (XDBSRA; XSSS) and Production (JABBA; ASPM) models	Catch history + abundance index	Catch, F, status
Length+catch models (if 1 yr: CC-SRA)	Catch history + length/age compositions	Catch; F; status
Statistical-catch-at-age (SS)	Catch history + index + length comps	Catch; F; status


Abs. abundance?
No
Available catch records and catches monitored
No
Invoke h(2); F rate limits
Yes
B- or #-based catch limits
Yes
Bio. comps?
No
Bio. comps?
Yes
No
Yes
No
Index?
Index?
Yes
No
Yes
No
Index?
No
Statistical catch-at-age
CC-SRA
Yes
No
Multiple indicators
LBRP; LBSPR; $\bar{L}$, LBB
Est. Recruitment
Yes
LIME
Yes
No
PSA; SAFE
$\frac{SB_t}{SB_0}$?
$\frac{SB_t}{SB_0}$?
Yes
Yes
No
XDB-SRA; XSSS
JABBA; ASPM
DCAC; DB-SRA; SSS; CMSY
ORCS; $\overline{Ct}$
Harvest pattern
Yes
COM-SIR; SS-COM
Indicator approach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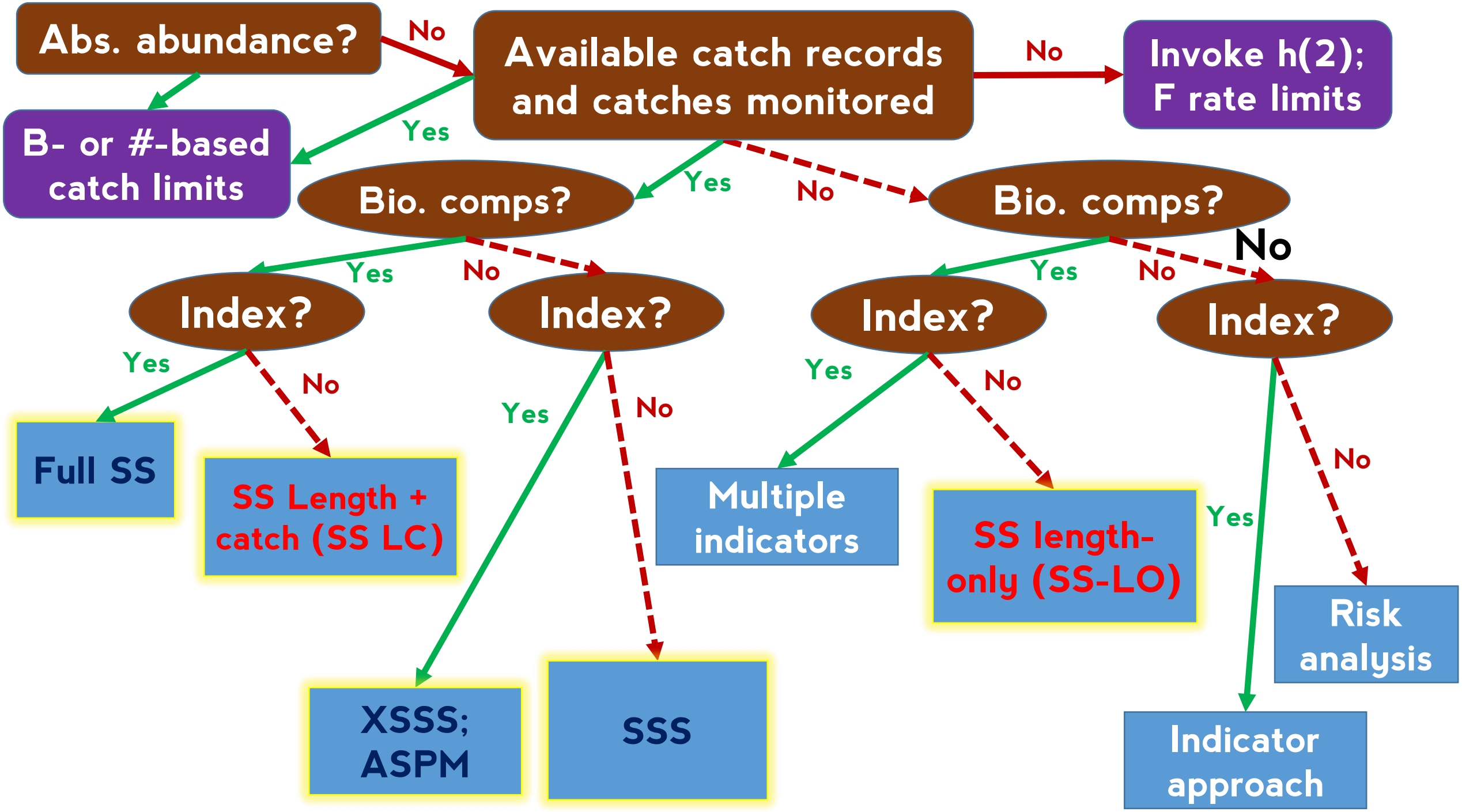
B- or #-based catch limits
Yes
Yes
No
Bio. comps?
Bio. comps?
Yes
No
Yes
No
No
Index?
Index?
Index?
Index?
Yes
No
Yes
No
Yes
No
Yes
No
SCA
Length + catch
Multiple indicators
Length-only
Risk analysis
Production models
Catch estimators
Indicator approach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B- or #-based catch limits
Yes
Bio. comps?
Yes
No
Bio. comps?
No
Yes
No
Index?
Yes
No
Index?
Yes
No
Index?
No
Index?
Yes
Full SS
No
SS Length + catch (SS LC)
Yes
XSSS; ASPM
No
SSS
Yes
Multiple indicators
No
SS length-only (SS-LO)
Yes
Indicator approach
No
Risk analysis

Benefits to common platform

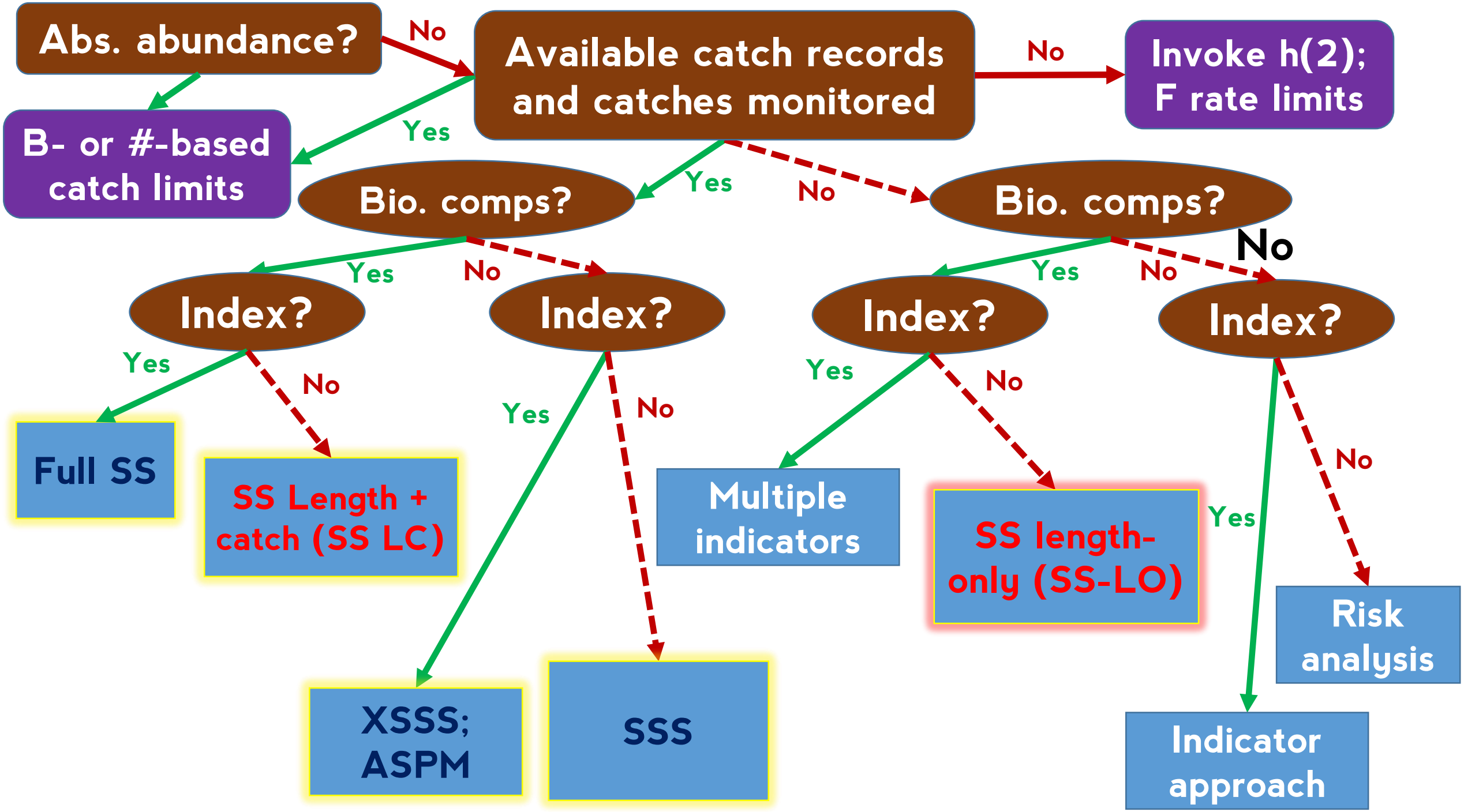
- Need only to learn one file system
  - Can add more information as it is available
- Leverage platform development from others
  - Features and flexibility
  - Diagnostics and visualizations
- Can compare different approaches/data uses more explicitly.
- Explicit adaptive management implications

Benefits of one tool approach

- Simplify connectivity between methods
  - Even when using SS as platform, approaches are not the same.

- Quicker exploration of model specification
  - SSS vs XSSS vs SS
  - What does adding different data do?

https://github.com/shcaba/SS-DL-tool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No
Yes
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Index?
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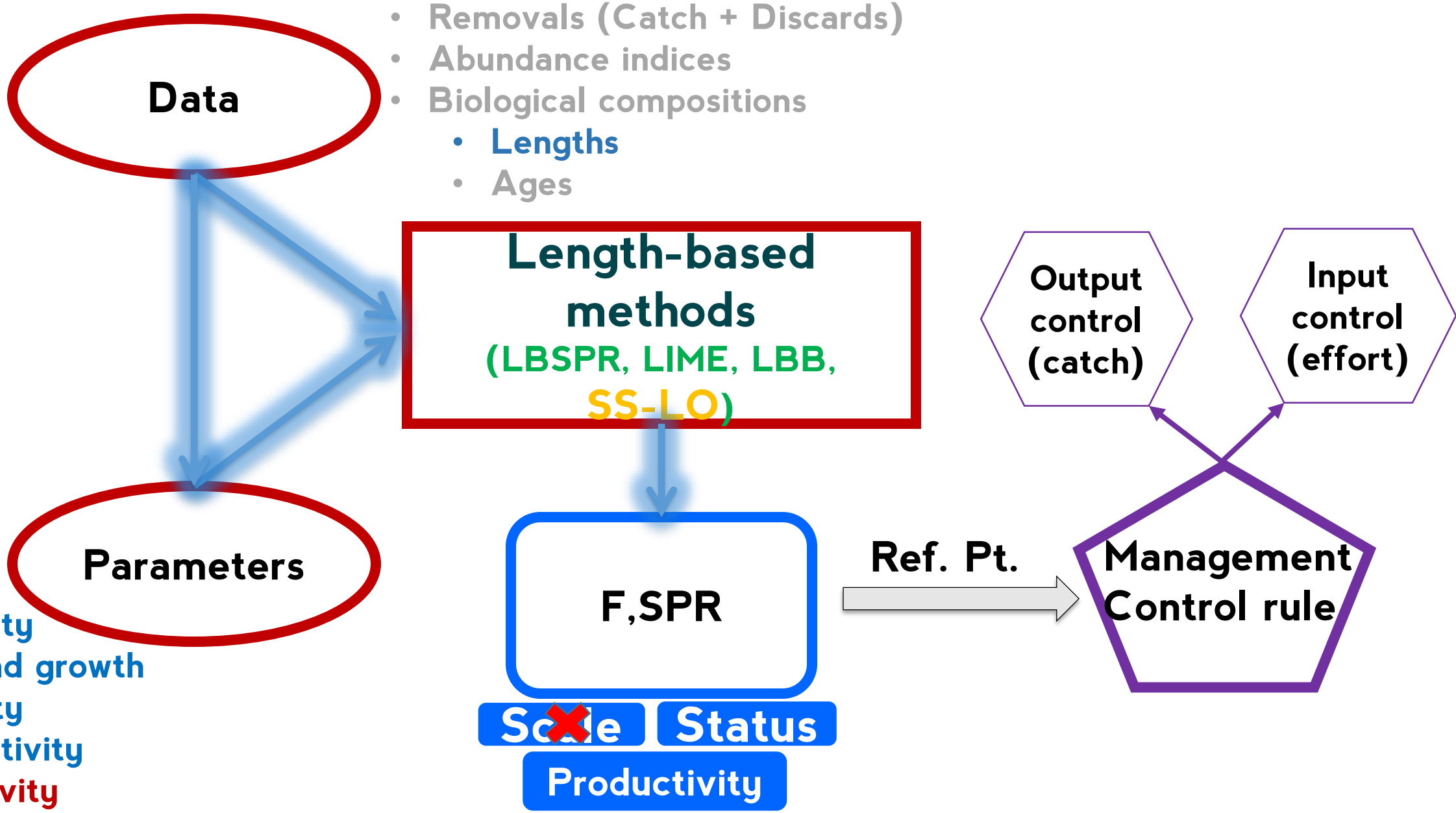
No
Index?
Index?
No
Yes
No
Yes
No
Yes
No
Full SS
SS Length + catch (SS LC)
Multiple indicators
SS length-only (SS-LO)
Yes
No
XSSS; ASPM
SSS
Indicator approach
Risk analysis

Applied stock assessment: Length-based

- Removals (Catch + Discards)
- Abundance indices
- Biological compositions
  - Lengths
  - Ages



- Mortality
- Age and growth
- Maturity
- Productivity
- Selectivity

Applied stock assessment: Length-based

- Removals (Catch + Discards)
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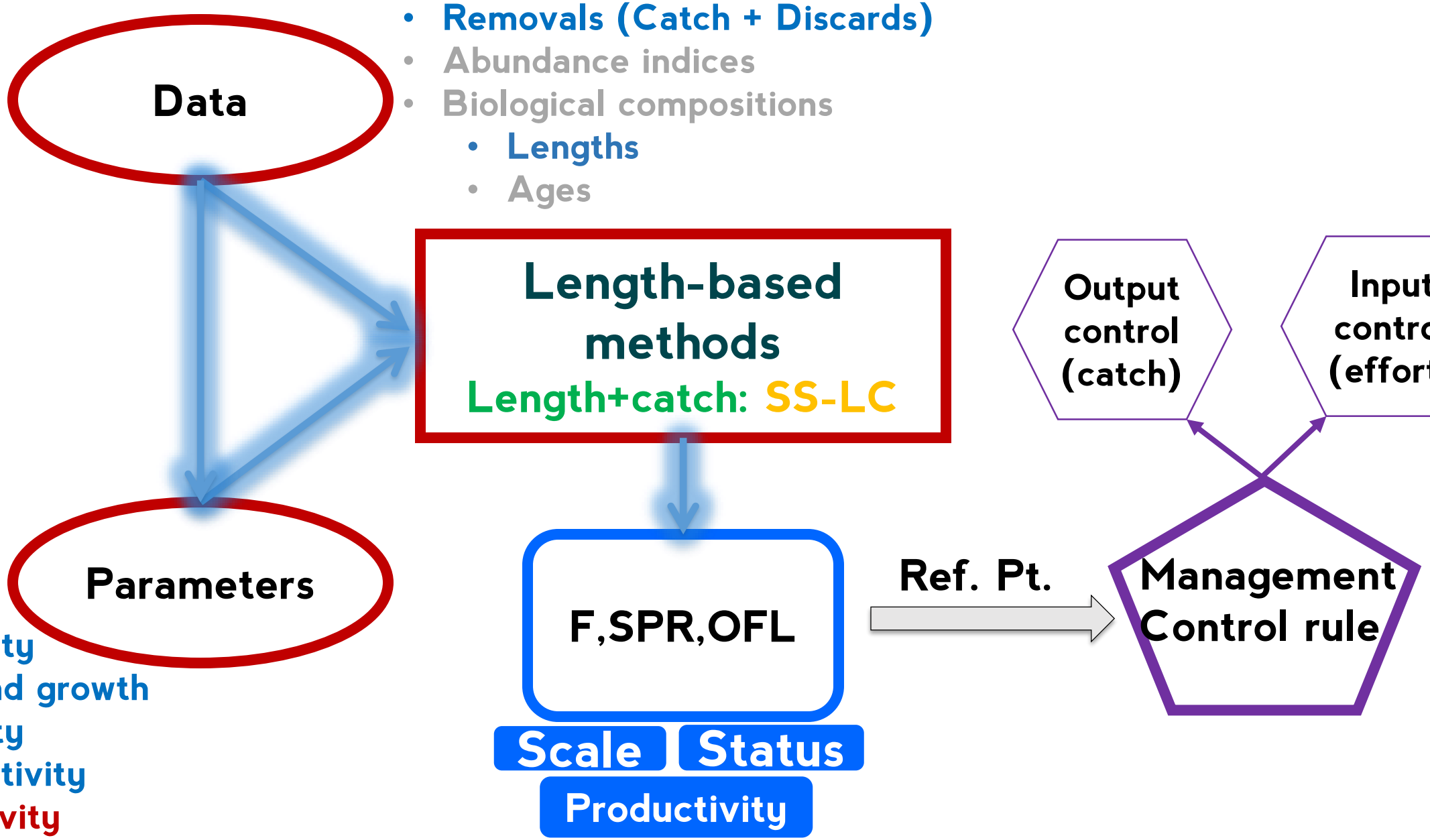
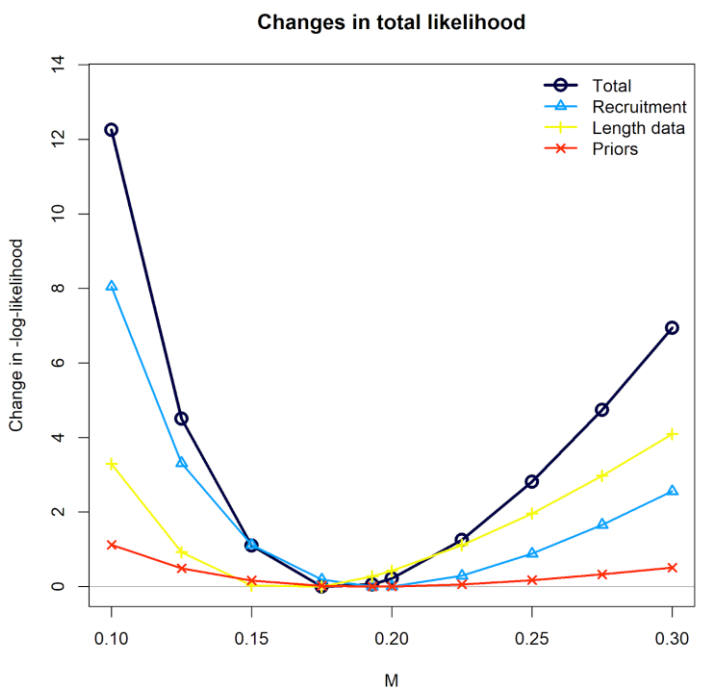
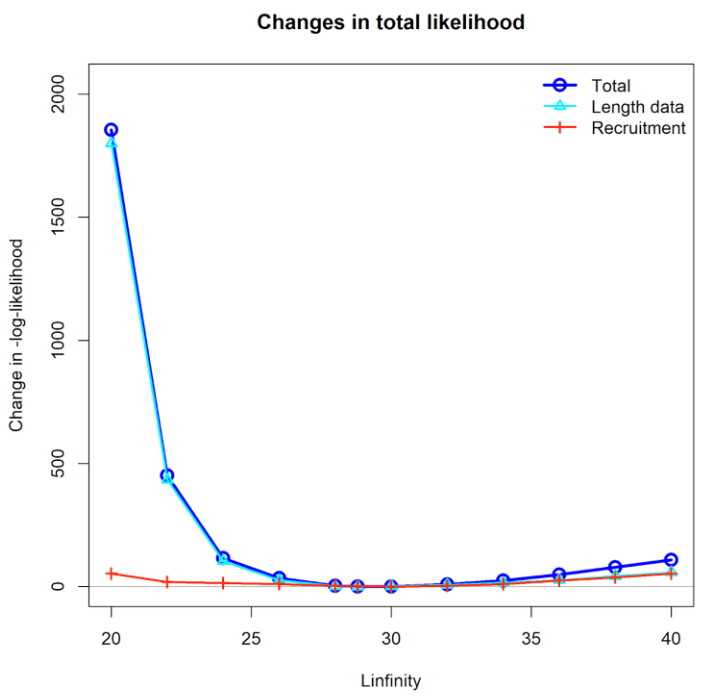
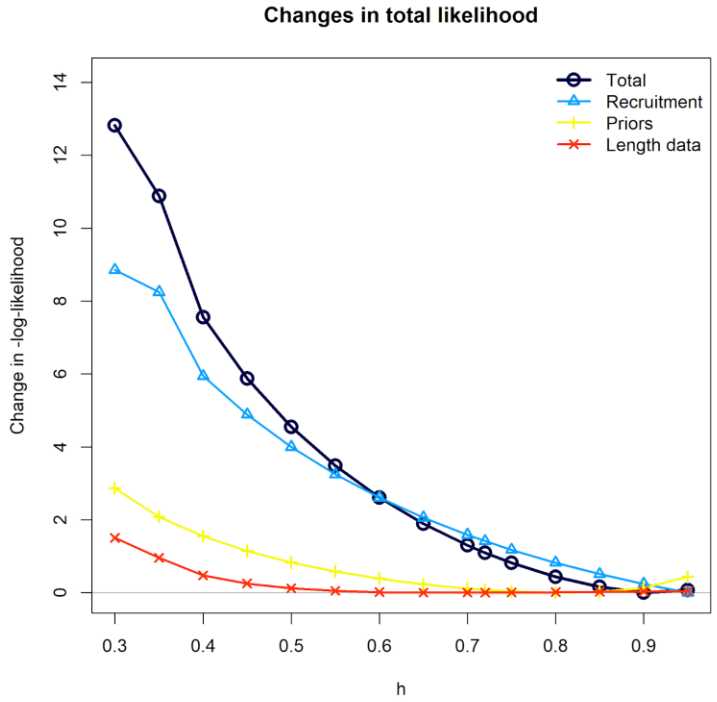


- Mortality
- Age and growth
- Maturity
- Productivity
- Selectivity

Length-only models: assumptions

- SPR is an analog to relative spawning output
  - SS-LO: outputs relative spawning output
- Females only
  - SS-LO: sex-specific data and parameters
- One fleet
  - SS-LO: Multiple fleets
- Asymptotic selectivity
  - SS-LO: Dome-shaped selectivity; sensitivities
- Limited life history detail
  - SS-LO: More options for sensitivities (e.g., length CV)
- No recruitment estimation (exception: LIME)
  - SS-LO: Estimates recruitment; integrates multiple years

Length-only models: set-up

- Estimate initial F
- Set catches to an arbitrary common value for all years. Very large CV is added.
- Add lengths
- Add biological parameters
- Define selectivity forms
- Choose whether to estimate recruitments
- Turn off catch likelihood; keep on the intial F likelihood

Estimating parameters: Likelihood profiles