WHAT EVIDENCE WOULD TELL US TO CHANGE COURSE?

Monitoring, evidence and adaptation

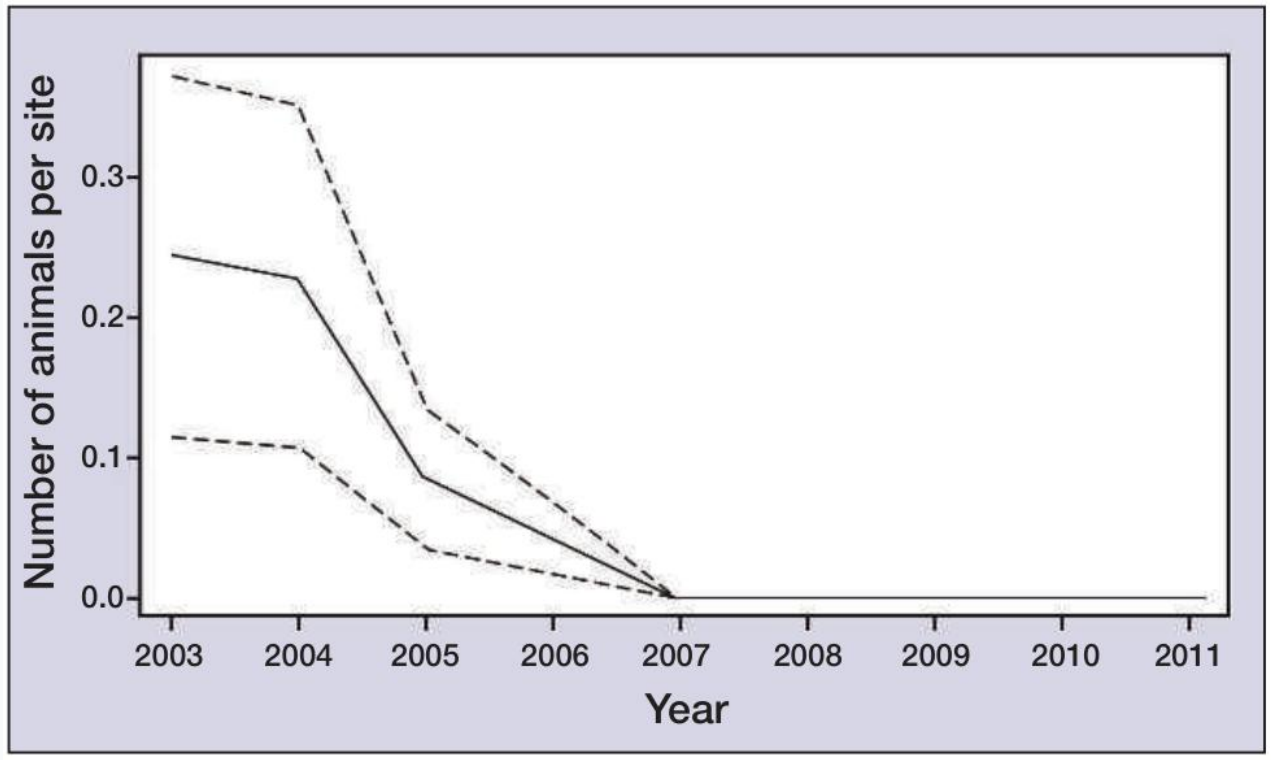
REAL PLANS. TESTABLE EXPECTATIONS. PREPARED RESPONSES.

From a monitoring record to a decision that can be revised.

The data were clear. The response was not.



Booderee: a historical local loss documented by a monitoring programme.



134

permanent monitoring sites

2003 → 2007

common at the start; no greater glider found by 2007

Missing

predefined triggers for management action

> **Detecting a decline is not the same as having a response ready.**

Lindenmayer, Piggott & Wintle (2013) | Original Fig. 3, p. 552

Two plans. Two different decisions.



BRIDGE RIVER

Which water-release regime should we choose?

Compare competing predictions over time.



GLADSTONE SEAGRASS

When should dredging be changed?

Detect harmful exposure early enough to respond.

The monitoring design follows the decision not the other way around.

Bradford, Korman & Sneep (2023); Chartrand et al. (2016)

Bridge River: more water, more fish?

A 26-year experiment in a regulated river, with juvenile salmonid biomass as the main indicator.

“HIGH-GOOD”

More wetted habitat could support more juvenile salmonids.

“LOW-GOOD”

Beyond rewetting, habitat-quality costs could outweigh extra wetted area.

YOUR PREDICTION?

Which observation would make you change it?

Bradford, Korman & Sneep (2023

This is what the field teams actually did.

Bridge River: the long-term fish study, complemented by the documented 2018 monitoring programme.

WHAT	HOW / WHEN	WHY THIS OBSERVATION?
Flow, stage and temperature	Continuous recording in the 2018 programme	Describe delivered conditions and their variability.
Juvenile fish abundance and biomass	Habitat-stratified sites; repeated September electrofishing	Evaluate the fish outcome under different regimes.
Periphyton accrual / peak chlorophyll	Weekly, 3 plates per index site; ~8 autumn weeks (2018)	Food-web / process-related information; not a direct metabolism rate.
Benthic invertebrates	Autumn sampling of abundance and composition	Examine food-web context alongside the fish result.

Compare regimes not just a line through years.

Twenty-six years included a baseline, planned changes and an unplanned high-flow period.

BASELINE

0

No dam release

FIRST RELEASE

3

Lower annual budget

HIGHER BUDGET

6

Seasonal schedule revised

HIGH FLOWS

~20

Unplanned infrastructure constraint

RETURN

6

Similar budget; different history

Annualized dam-release water budgets (m^3/s)

Sequential regimes in one river; unequal durations; the high-flow trial was opportunistic.

Repeated sites provide information within a river; they are not independent river-scale treatments.

The highest release did not yield the most fish.

The reported juvenile-salmonid response favoured the “low-good” prediction.

RESULT	Total juvenile biomass was highest at the lowest release regime tested.
IMPORTANT CHECK	Returning to a previous flow budget did not immediately restore earlier abundance and biomass.
LIMIT	This does not identify the best flow for every river or every conservation objective.

A useful programme can reject an expectation without resolving every mechanism.

An observation changed the next trial.

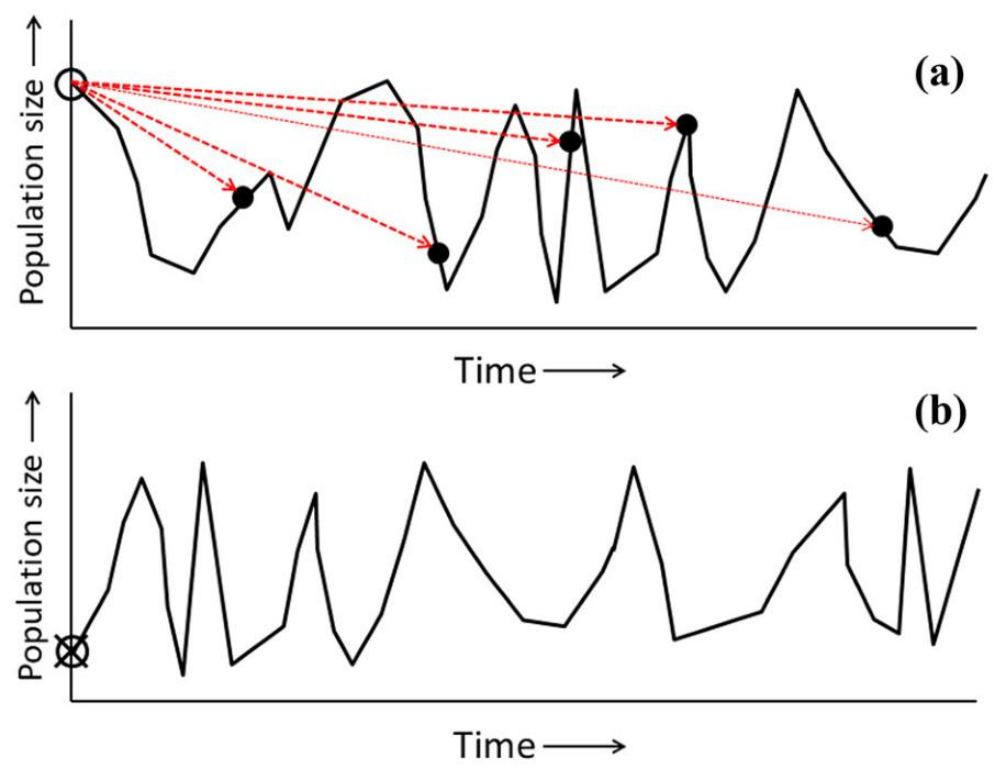
Chinook salmon: distinguish the observation, the explanation and the revised action.

1	OBSERVED	Juvenile Chinook abundance declined after releases began.
2	HYPOTHESIZED	Warmer autumn–winter water could accelerate development and alter emergence timing.
3	CHANGED	The next release schedule reduced autumn–winter flows instead of simply doubling every month.
4	CHECKED	The reported cooling effect was modest: about 0.5°C for October–December in later trials.

Adaptive management includes checking whether the revised action affected the proposed mechanism.

Would you start where the animals are most abundant?

A plausible field decision can create a biased starting point.



Choose a site

Which population looks easier to monitor?

Inspect the start

Is that initial abundance typical?

Ask the design question

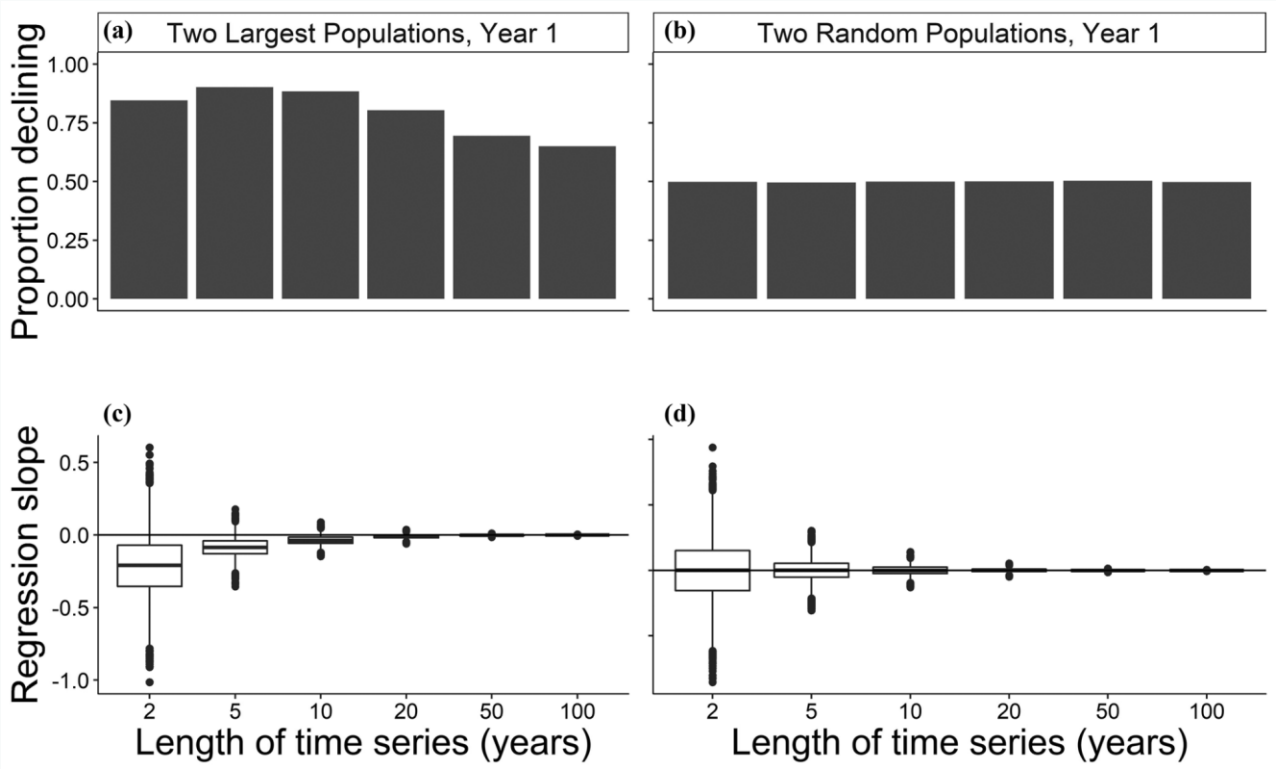
Would a different selection rule change the apparent trend?

A monitoring baseline is also a consequence of how the sites entered the study.

Fournier, White & Heard (2019) | Original Fig. 1, p. 1371

The sampling rule can change the trend.

The same simulated populations; abundance-based selection versus random selection.



LEFT

Initially largest populations selected.

RIGHT

Populations selected at random.

READ THE TOP ROW

Negative estimated slopes—not necessarily statistically significant declines.

Document the selection rule; more years do not automatically erase its consequences.

Fournier, White & Heard (2019) | Original Fig. 2, p. 1373

“No clear increase” can mean two different things.

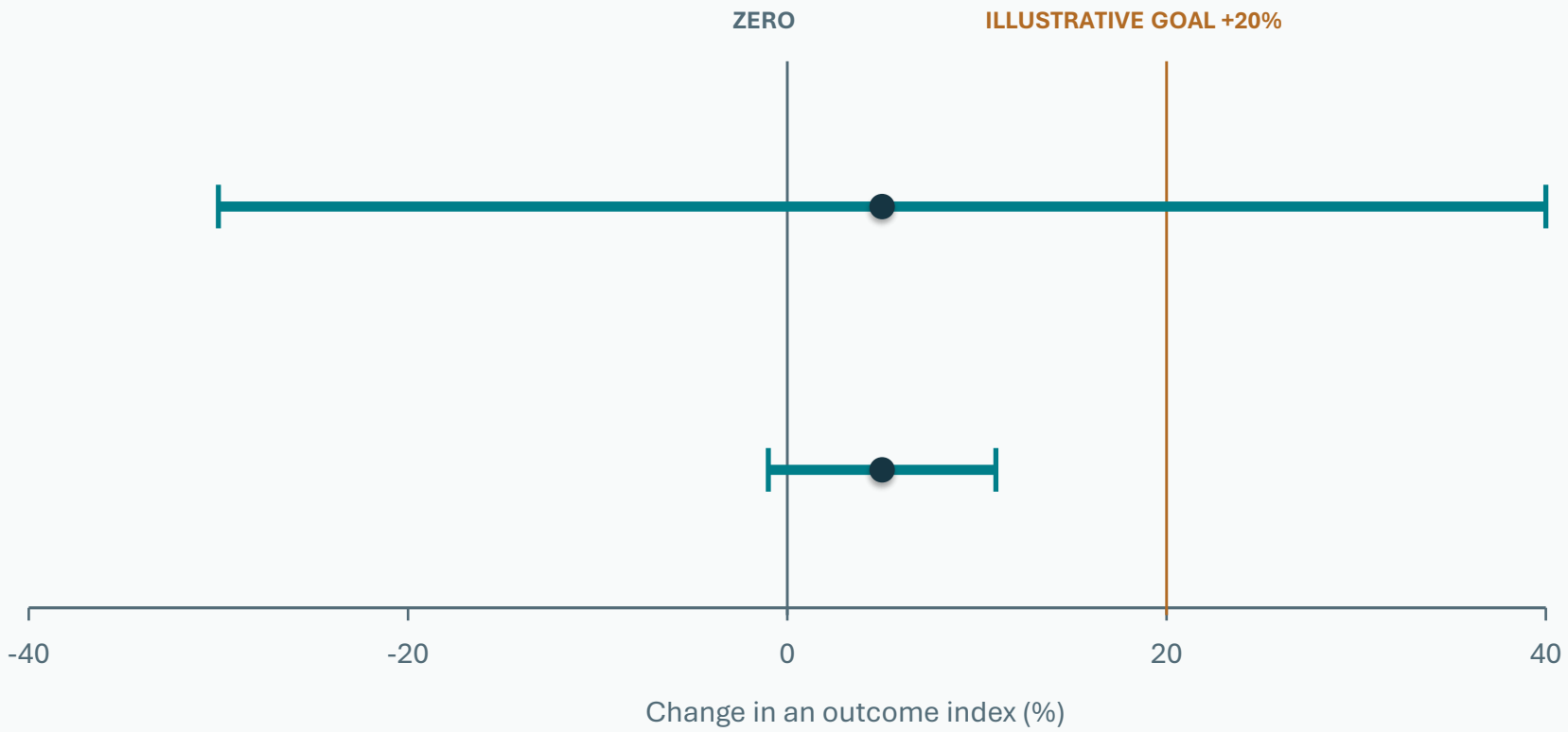
Both estimates are +5%. Both intervals include zero.

A / IMPRECISE

+5% [-30%, +40%]

B / MORE PRECISE

+5% [-1%, +11%]

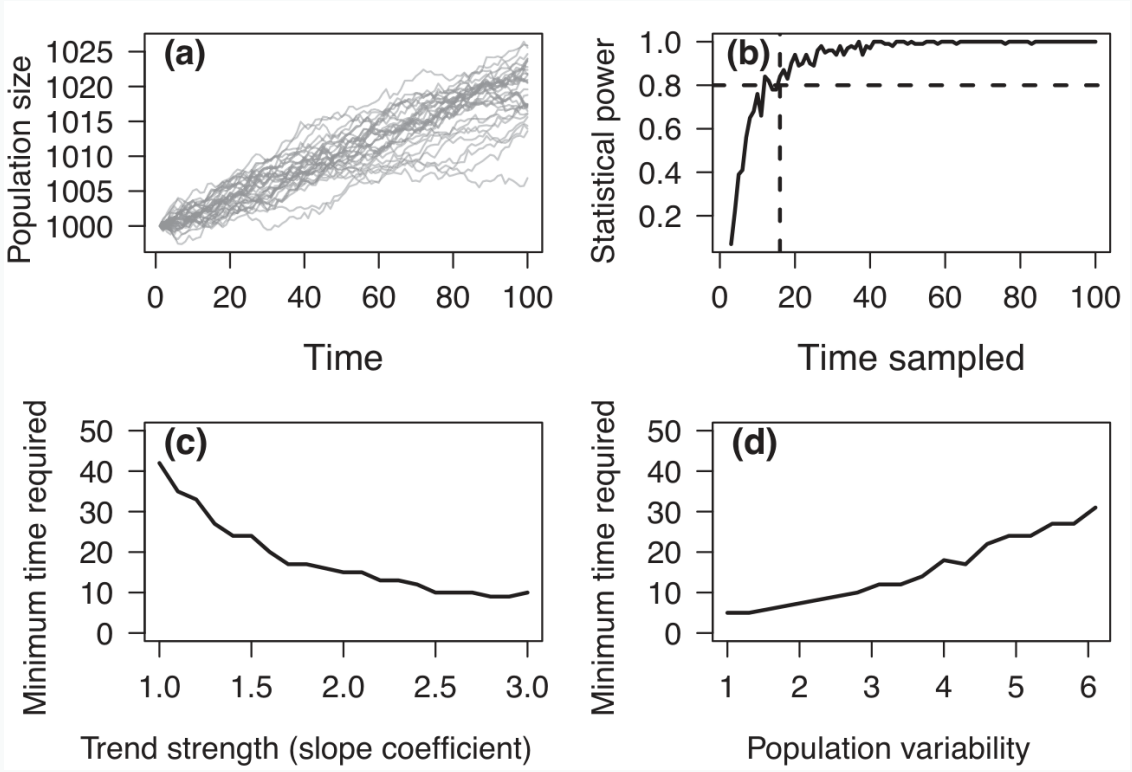


Compare the uncertainty with a meaningful change.

White (2019)

Would your plan detect the change that matters?

Power analysis turns a vague sampling ambition into a testable design question.



A → B

Simulated records → frequency of detecting the imposed trend.

C

Stronger trends require fewer years in this model.

D

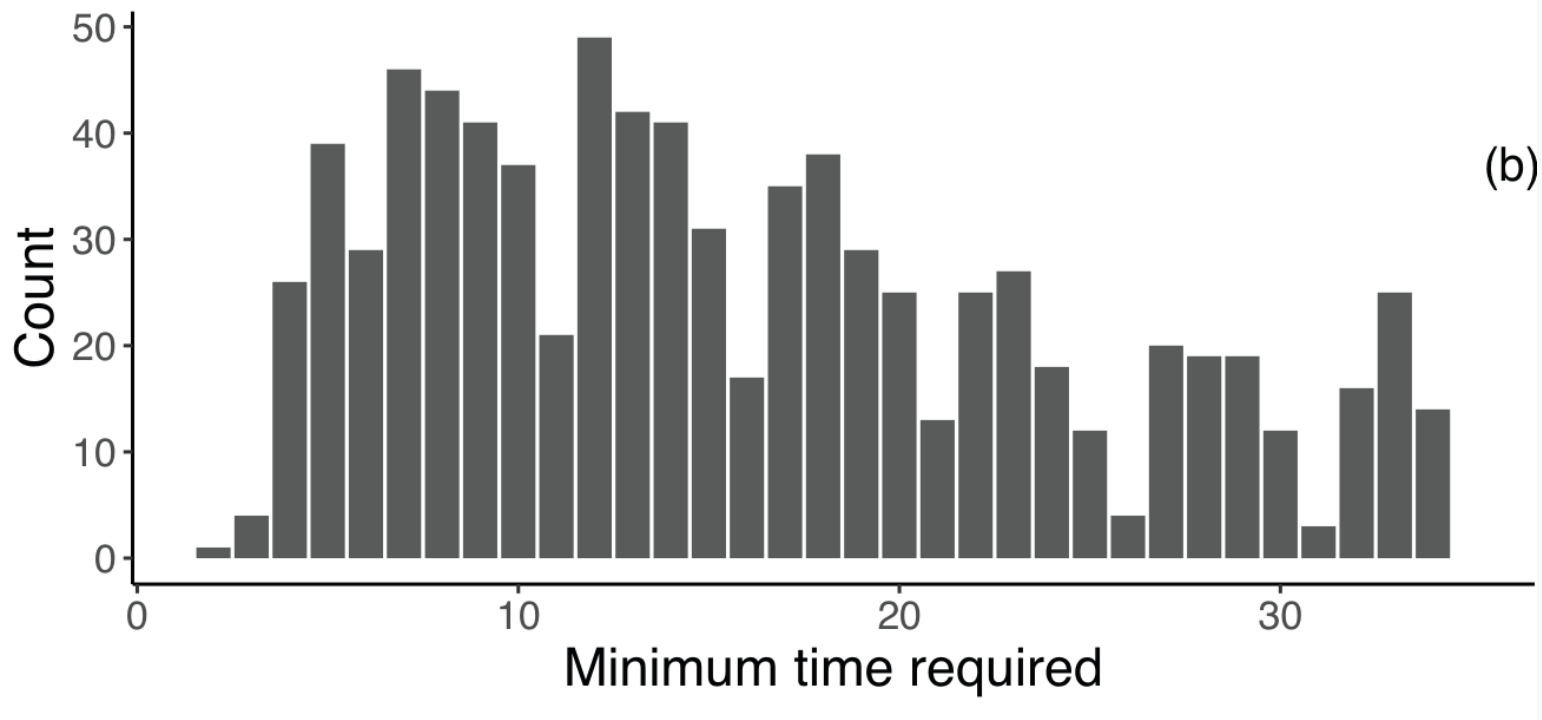
More variable populations require more years.

Specify the change, the time horizon and the acceptable error before fixing the survey effort.

White (2019) | Original Fig. 1, p. 42

Ten years is not a universal answer.

Estimated requirements for detecting linear trends in 822 vertebrate population series.



72%

required at least 10 years under the study's criterion

SCOPE

477 species; 747 of 822 records were birds

DECISION

This is not a rule to postpone protective action.

Design around the question and the population

White (2019) | Original Fig. 2b, p. 43

One hundred surveys. How would you spend them?

The same ten-step horizon and the same total effort in every option.

A

50 sites
× 2 visits

B

25 sites
× 4 visits

C

20 sites
× 5 visits

D

10 sites
× 10 visits

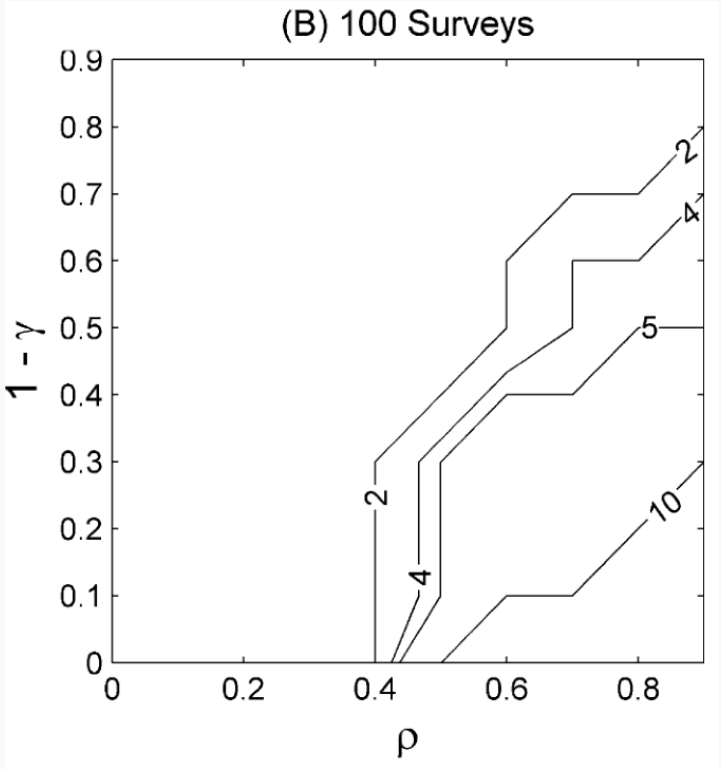
What do you need to know about correlation, observation error and costs?

Choose an allocation and state the assumption that makes it sensible.

Rhodes & Jonzén (2011)

Spend effort on information, not repetition.

The preferred balance depends on how populations co-vary across space and time.



RIGHT

Stronger spatial correlation.

UP

Stronger temporal correlation.

CONTOURS

Preferred number of visits per site: 2, 4, 5 or 10.

The pattern is a model-based design

Rhodes & Jonzén (2011) | Original Fig. 1B, p. 1043

When would you stop the dredge?

Gladstone: protect Zostera muelleri before visible meadow loss.

ACTIVITY

Dredging

→

EXPOSURE

Light reaching the canopy

→

OUTCOME

Seagrass cover and biomass

The management question is not “Is the water cloudy?”

It is “How much harmful exposure can we allow before we respond?”

> **Measure exposure early; keep checking the ecological outcome.**

Chartrand et al. (2016) | Source-based teaching reconstruction

First calibrate the alarm.

Local shading experiments + 46 months of field observations.

FIELD EXPERIMENT

Three shade treatments + controls
4 replicate plots per treatment

BACKGROUND RECORD

46 months of light, vegetation
and environmental observations

GROWING SEASON	Persistent shading caused cover / biomass loss after several weeks.
SENESCENT TRIALS	No comparable detectable shading effect in those trials.

The experiment tests light stress

A warning value needs biological calibration, a relevant time window and local context.

The operating evidence has a place and a clock.

Separate measurement frequency, integration window and ecological checks.

MEASUREMENT	PROTOCOL / WINDOW	DECISION ROLE
Benthic light (PAR)	15-minute readings → daily totals → 14-day rolling mean	Exposure alert; calibrated locally.
Seagrass cover / biomass	Repeat observations on fixed transects and quadrats	Check the protected outcome.
Temperature, rainfall, tidal exposure	Environmental context accompanying the field record	Interpret natural variation and other stressors.
Turbidity and background conditions	Considered alongside light during management	Investigate dredging versus other causes.

LOCAL RULE **6 mol photons m^{-2} d^{-1} as a 14-day mean, for the relevant growing season.**

Chartrand et al. (2016) | Source-based teaching reconstruction

The response was planned before the next result.

Historical WBDDP escalation schedule, described in a 2019 procedure.

14	16	18 / 20	21	28
CHECK	CONVENE	ESCALATE	MITIGATE	REFERENCE
Validate data; investigate causes.	Technical management review.	Additional management steps.	Stop or modify dredging activity.	Earliest decline cited from experiments.

Days below threshold / milestones as described in the historical procedure

> **Leave time between the alert, the decision and the biological impact.**

Gladstone Ports Corporation (2019), §6.6.2, pp. 28–29; Chartrand et al. (2016) | Source-based teaching reconstruction

Day 16. The plants still look unchanged.

Teaching scenario: the validated low-light trigger persists during the relevant season.

A Wait for a detectable loss of seagrass cover.

B Follow the scheduled technical review and examine causes and mitigation.

C Declare that dredging has already caused ecological damage.

Choose the response AND the claim that the evidence supports.

> **An early-response rule can justify action without proving that damage has already occurred.**

Gladstone Ports Corporation (2019), §6.6.2, pp. 28–29; de Bie, Addison & Cook (2018)

The number is only one part of the rule.

de Bie: decision context → available action → trigger → monitoring, action and review.

MEASURE

Which indicator and protocol?

INTERPRET

Which window, baseline and uncertainty?

ACT

Which condition activates which response?

ACCOUNT

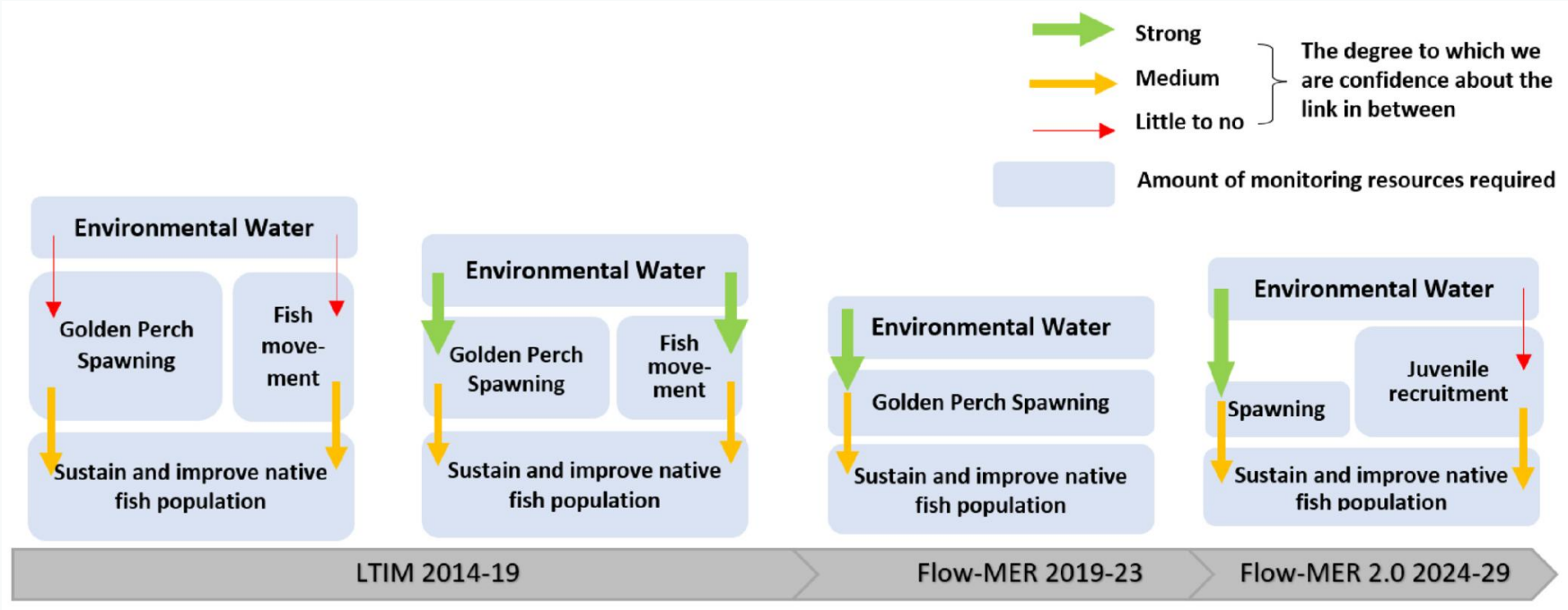
Who checks, authorises and reviews?

A trigger is useful only when a feasible, authorised response is attached to it.

de Bie, Addison & Cook (2018)

Learning can change the monitoring priorities.

Lower Goulburn: improved knowledge of flow and spawning changes the value of further monitoring.



REPORTED

Movement monitoring dropped

DECIDED

40% spawning-survey reduction

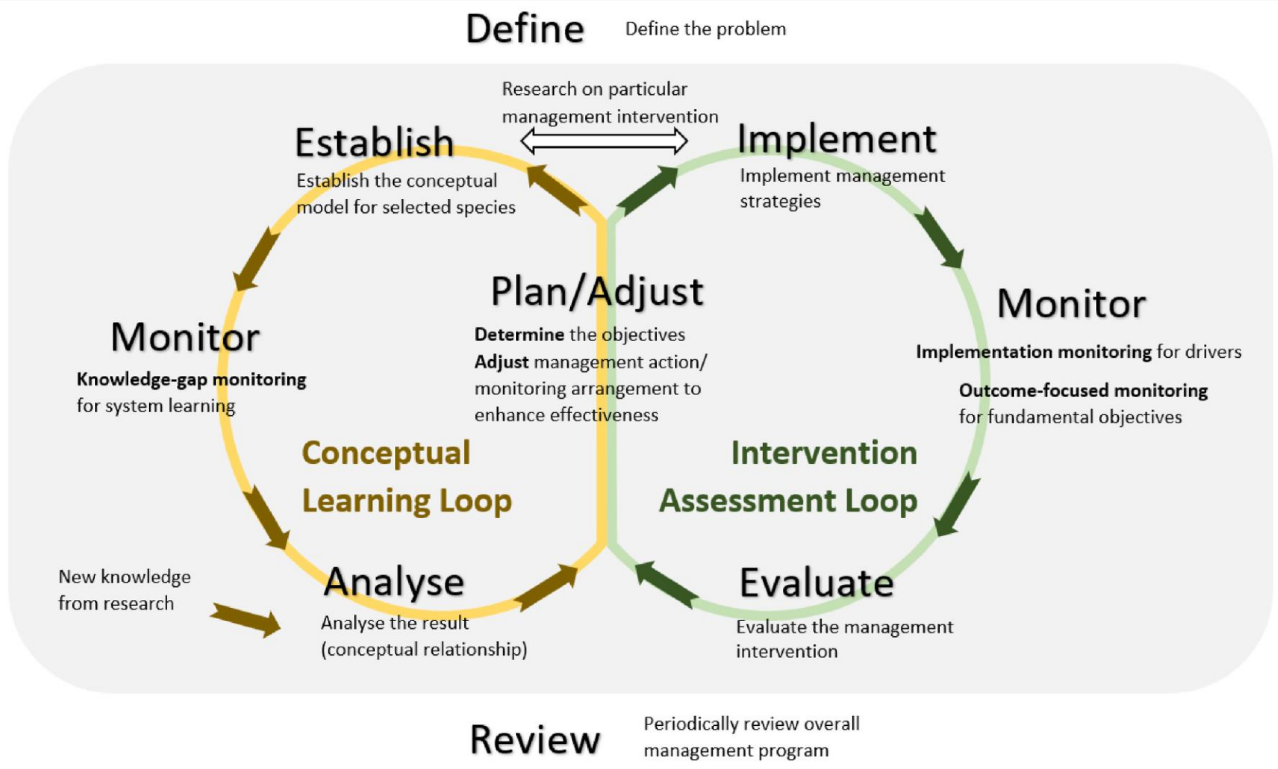
PROPOSED

Further shift to recruitment questions

Dai et al. (2025) | Original Fig. 5, PDF p. 7

Keep the outcome record. Adapt the investigation.

Two connected jobs: evaluate the intervention and resolve the uncertainty that limits the next decision.



RIGHT LOOP

Did the intervention meet the objective?

LEFT LOOP

Which uncertainty needs a targeted test?

LINK

Use the learning to revise management or monitoring.

Learning should improve the next decision without destroying the long-term comparison.

Dai et al. (2025) | Original Fig. 3, PDF p. 5

Three different reasons to change course.

The evidence may challenge the action, the observation design or the next learning priority.

1	CHANGE THE ACTION	Bridge River: test a different release schedule when evidence challenges an expectation.
2	CHANGE THE RESPONSE	Seagrass: follow an agreed escalation before the outcome deteriorates.
3	CHANGE THE INVESTIGATION	Goulburn: redirect effort when a critical uncertainty has been reduced.

Revising a plan is not moving the goalposts. Keep the conservation objective explicit.

Bradford, Korman & Sneep (2023); Chartrand et al. (2016); Dai et al. (2025)

Build the monitoring plan another team could run.

Seven-minute project task: one outcome indicator and one complementary pressure or process indicator.

DECISION	Which choice will the evidence inform?
MEASURES	What will be observed, where, how and when?
COMPARISON	What baseline or reference supports the inference?
RESPONSE	Which result activates which action and who can authorise it?

> **Produce a one-page plan, not a promise, to “monitor biodiversity”.**

de Bie, Addison & Cook (2018); Stoffels et al. (2024)

Could another team execute your plan?

Exchange plans. Find one strength and one fix that would make the evidence usable.

1	INTERPRETATION	Could the indicator give a reassuring result for the wrong reason?
2	DESIGN	Would this plan detect or distinguish the change that matters?
3	FOLLOW-THROUGH	If the trigger were crossed, who would do what and when?

> **A useful criticism identifies the observation or decision that needs to change.**

de Bie, Addison & Cook (2018)

What evidence would tell YOU to change course?

“If we observe _____,
we will _____,
because _____.”

Keep the objective explicit. Make the next decision testable.

Journal club: what does the evidence support?

Haase et al. (2023) — a separate journal-club discussion.

1	MEASURES	Which dimensions of biodiversity are measured? Which processes are not?
2	DESIGN	What do the sites, start dates and time windows allow us to infer?
3	DECISION	Which claim is a trend, which is causal, and what would select a management response?

Haase et al. (2023) — separate journal club

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