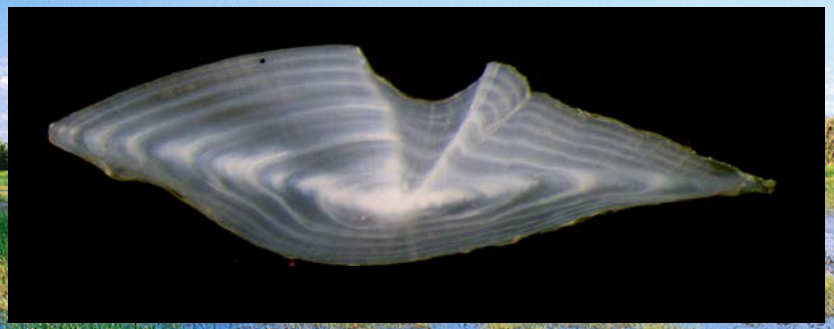
Otoliths (fish ear stone): natural recorders of change in aquatic environments



Dr John Morrongiello
School of BioSciences
University of Melbourne

THE UNIVERSITY OF MELBOURNE

Monitoring in Northern Australia

James Shelly

Dave Crook

Steve Parish

Tremendous biodiversity

Geographic isolation and biological novelty pose problems for traditional monitoring

Despite these challenges….

We need to understand what is going on

Majority of habitats are in good order

Natural and human-induced change

Fish are a key biological indicator

Social, cultural, and economic value

Play essential ecological role in aquatic environments

Sensitive to a range if drivers

Integrate system-wide response

Traditional fish monitoring

Provides point estimate of abundance

Requires long-term labour-intensive sampling

What is driving observed changes?

Often lacks a mechanistic underpinning

Can we monitor fish better?

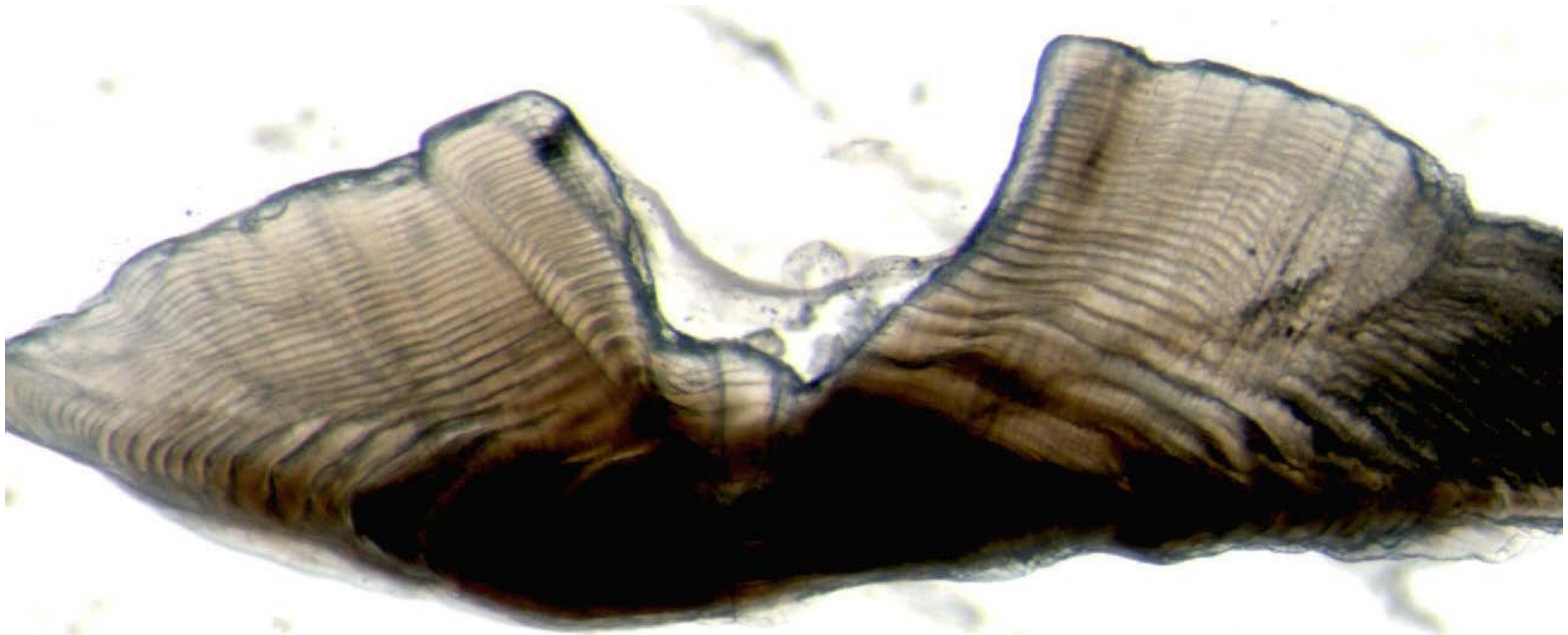
Remotely

Cheaply

Process-based insight

Yes

Otoliths: let the fish do the work!

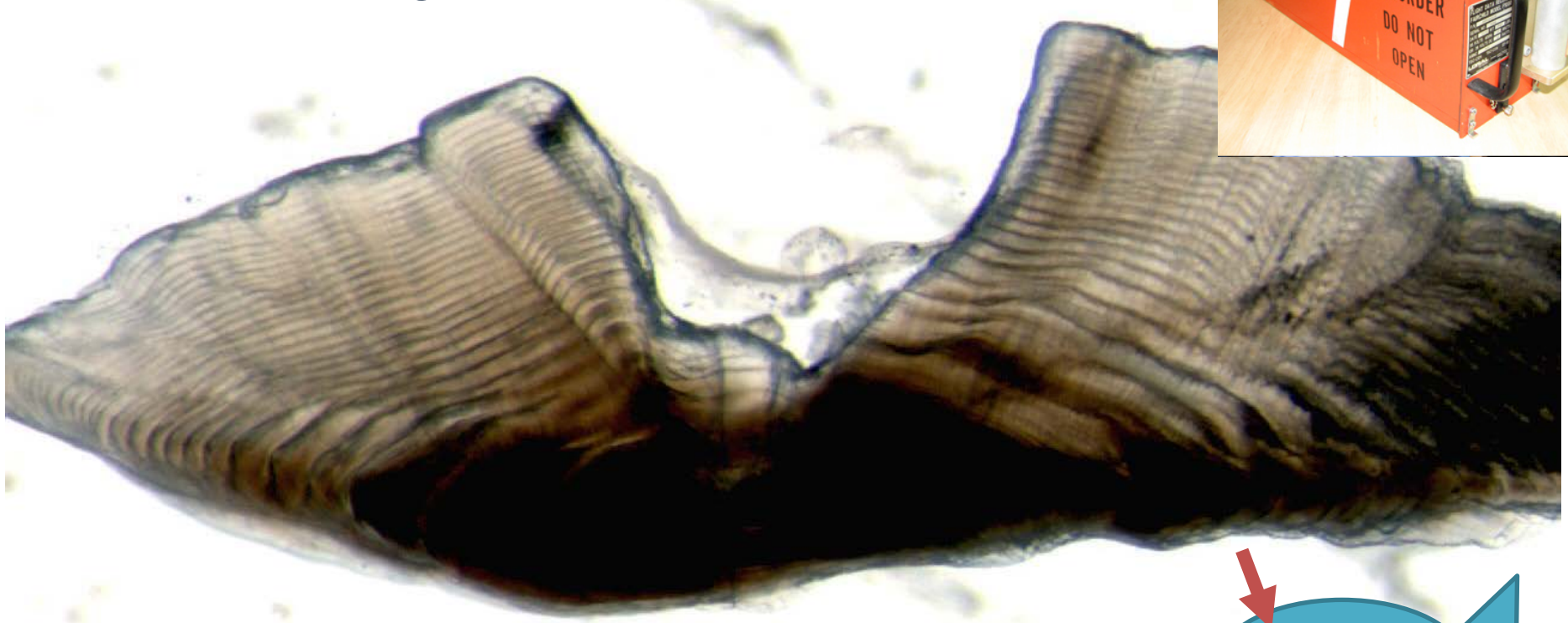


Otoliths- fish ear stone

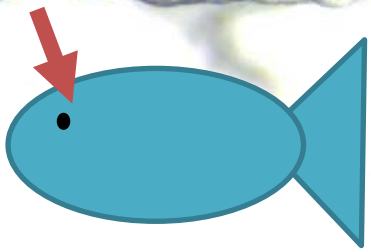
Natural archives of biological information

When was a fish spawned?

How fast has it grown across its life?



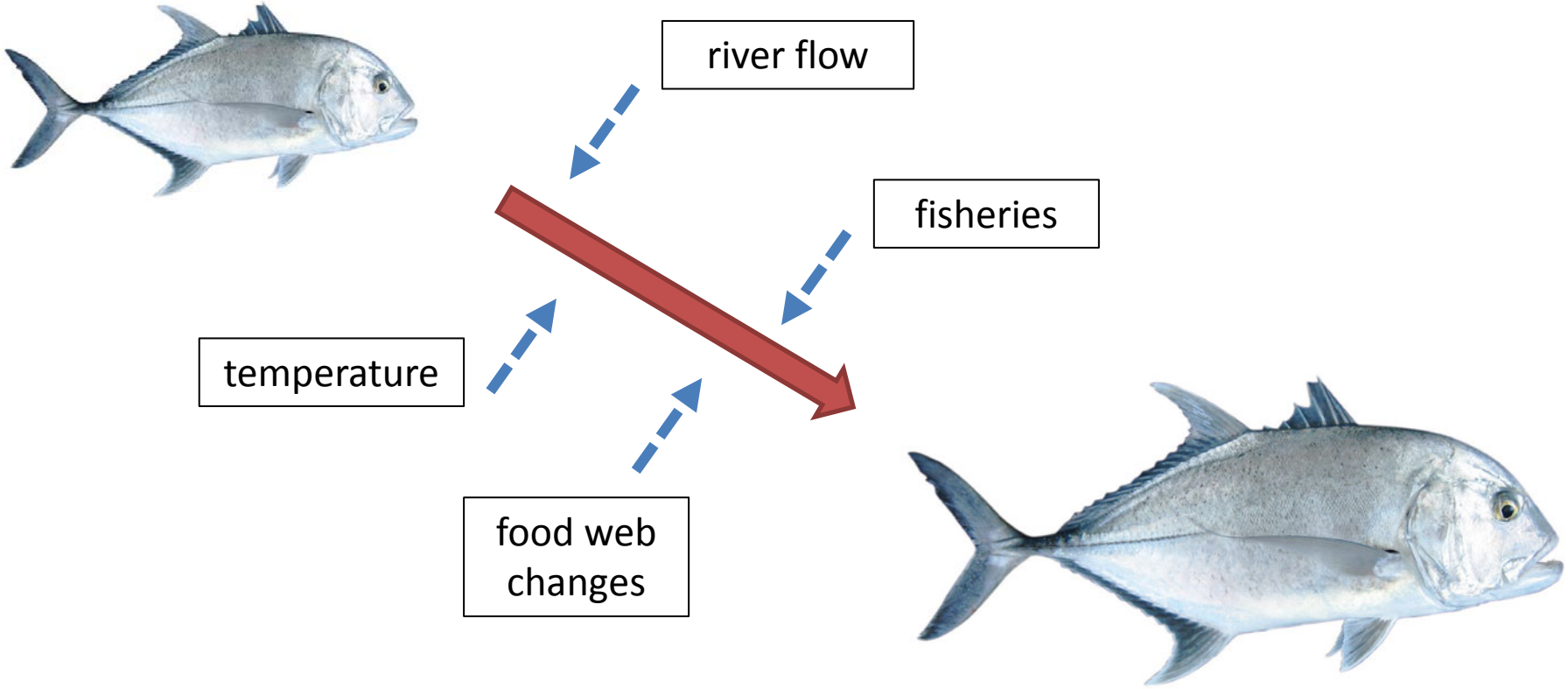
26 yo banded morwong



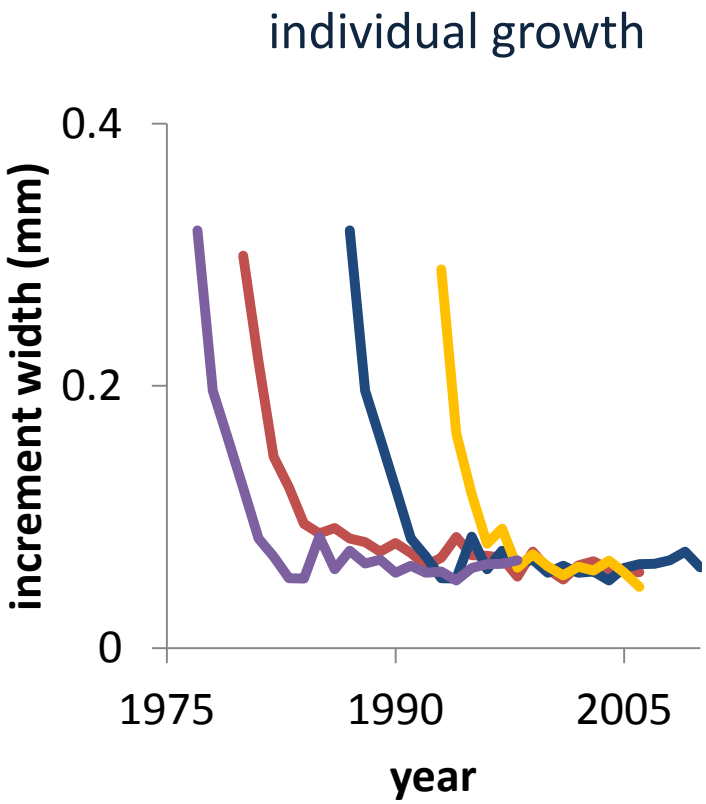
Growth as a biological indicator

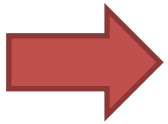
Underpins individual fitness & population-level metrics

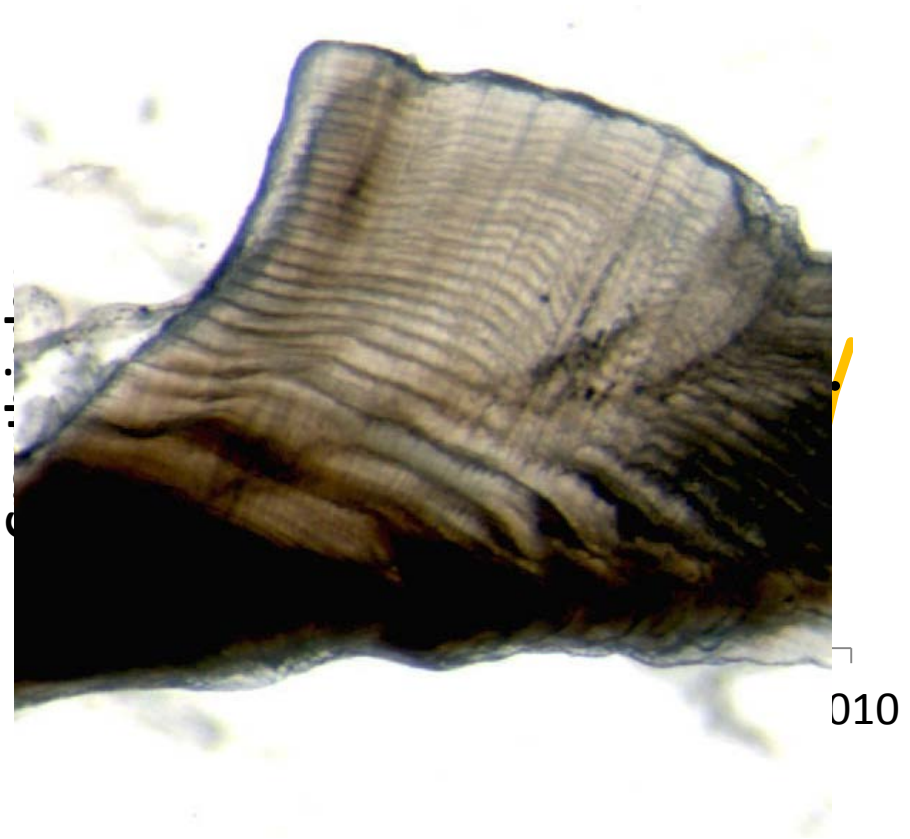
Sensitive to multiple drivers of change



Morrongiello *etal* (2012) *Nature Climate Change*







Morrongiello & Thresher (2015) *Ecological Monographs*

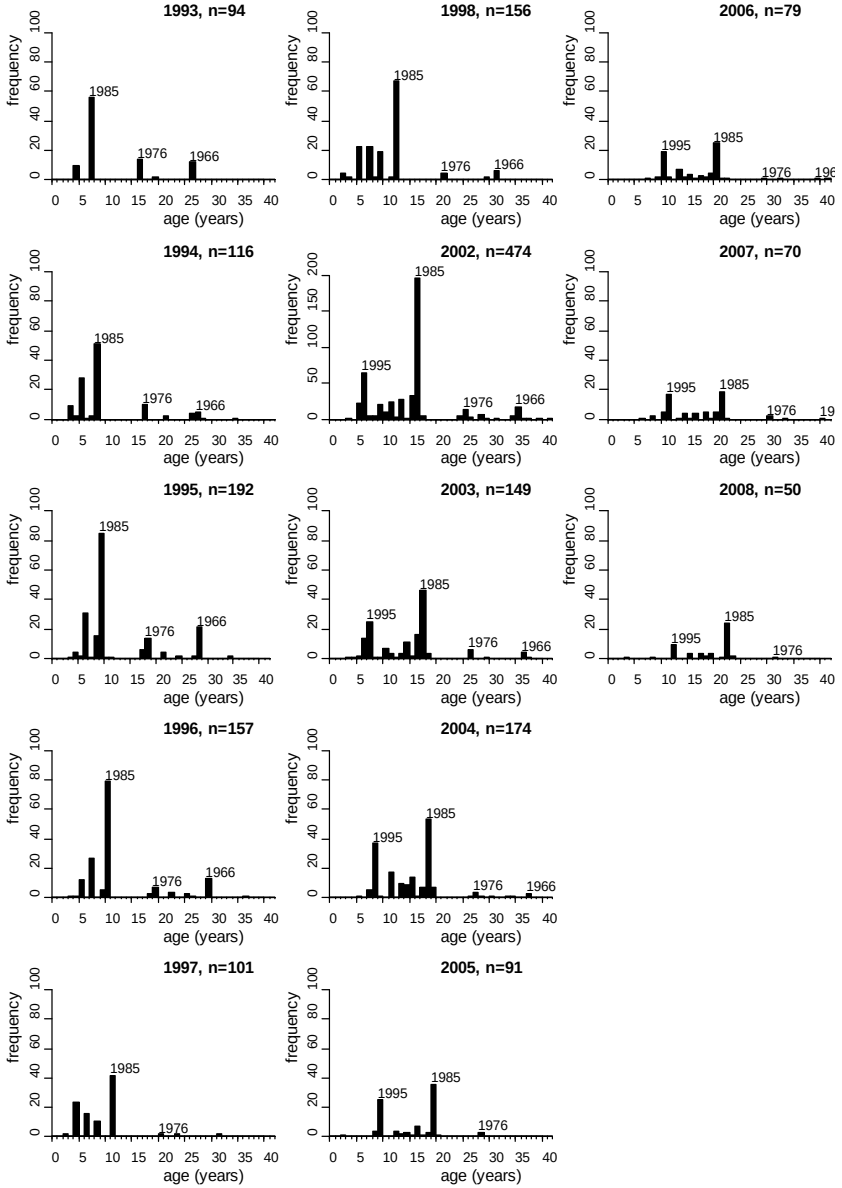
Estuary perch

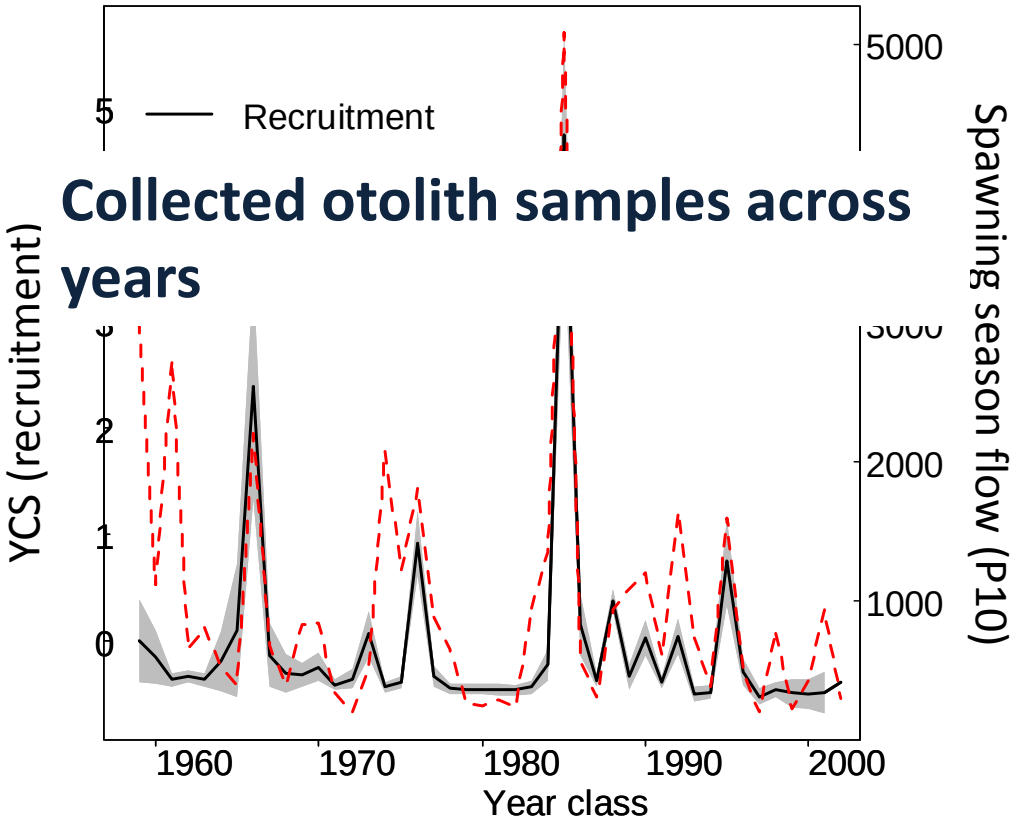
Flow and temperature driven recruitment and growth dynamics

Morrongiello *etal* (2014) *Global Change Biology* **20**: 1844-1860

Sydney
Canberra
Victoria
Bemm River
Melbourne
Bass Strait
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
Google earth

Recruitment

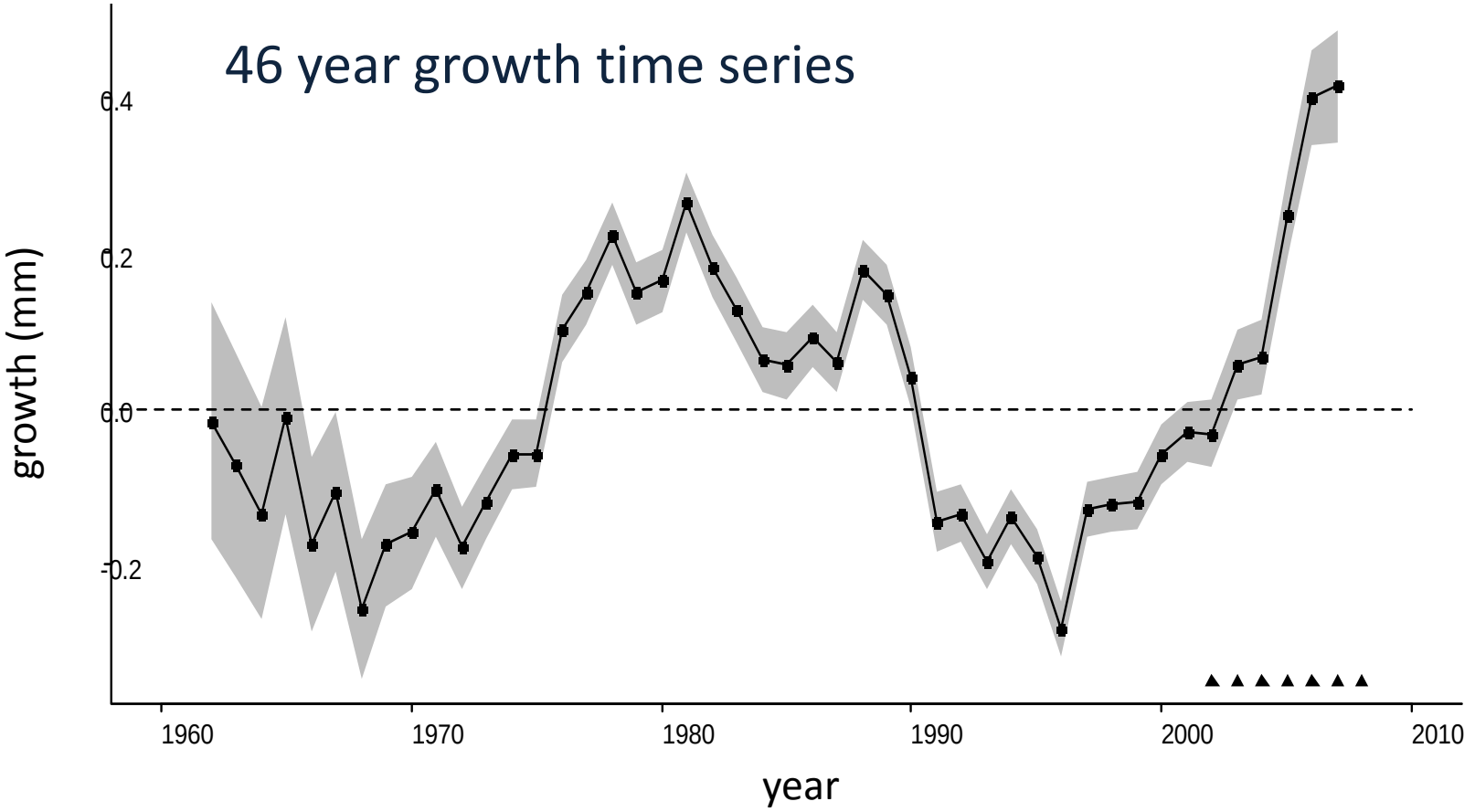




Collected otolith samples across years

High flows in spawning season important for recruitment

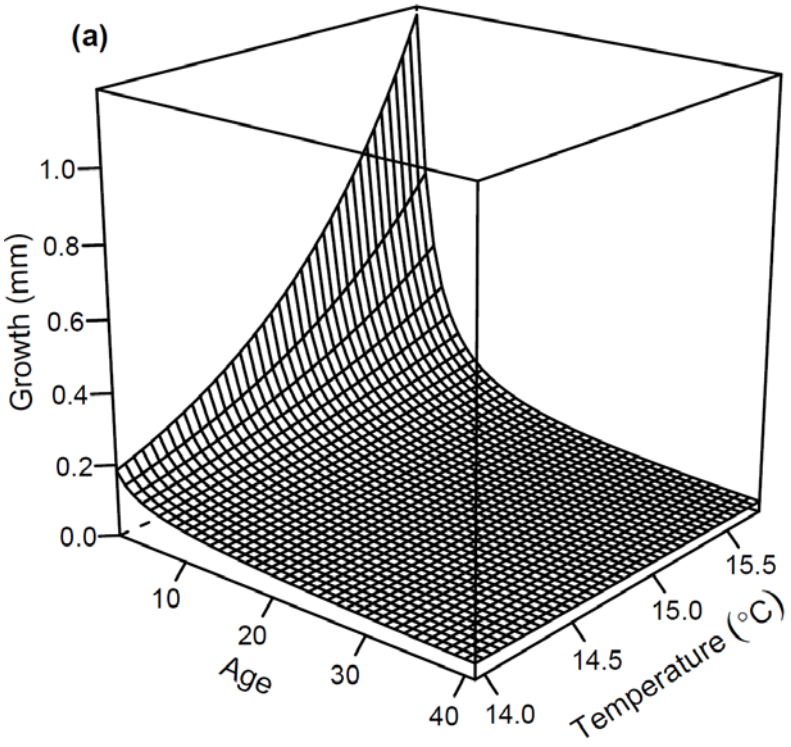
Growth



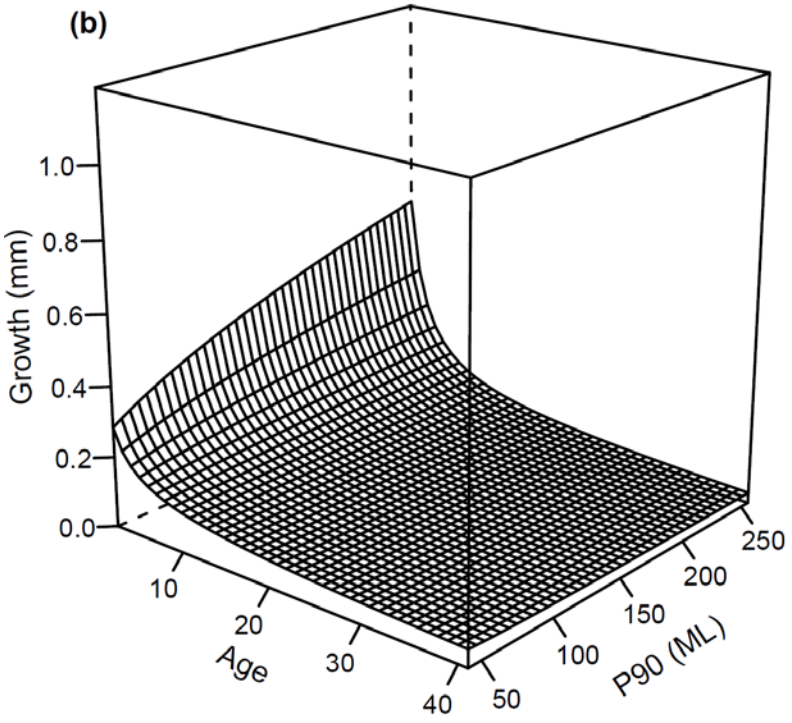
Morrongiello *etal* (2014) *Global Change Biology* **20**: 1844-1860

Growth

Age-dependent temperature



Age-dependent flow



Biology is complex: traits respond to multiple and changing drivers

Models for prediction, e.g. response to flow changes

Morrongiello *etal* (2014) *Global Change Biology* **20**: 1844-1860

Current work:

“Influence of freshwater flows on growth and abundance of barramundi and mud crab in the Northern Territory”

Alison King, Dave Crook, Mark Grubert, Thor Saunders, Michael Douglas, John Morrongiello

Constraints

Need otoliths!

Destructive sampling of fish

Lagged detection of biological change (not real-time monitoring)

Model calibration

Benefits

Unprecedented temporal resolution

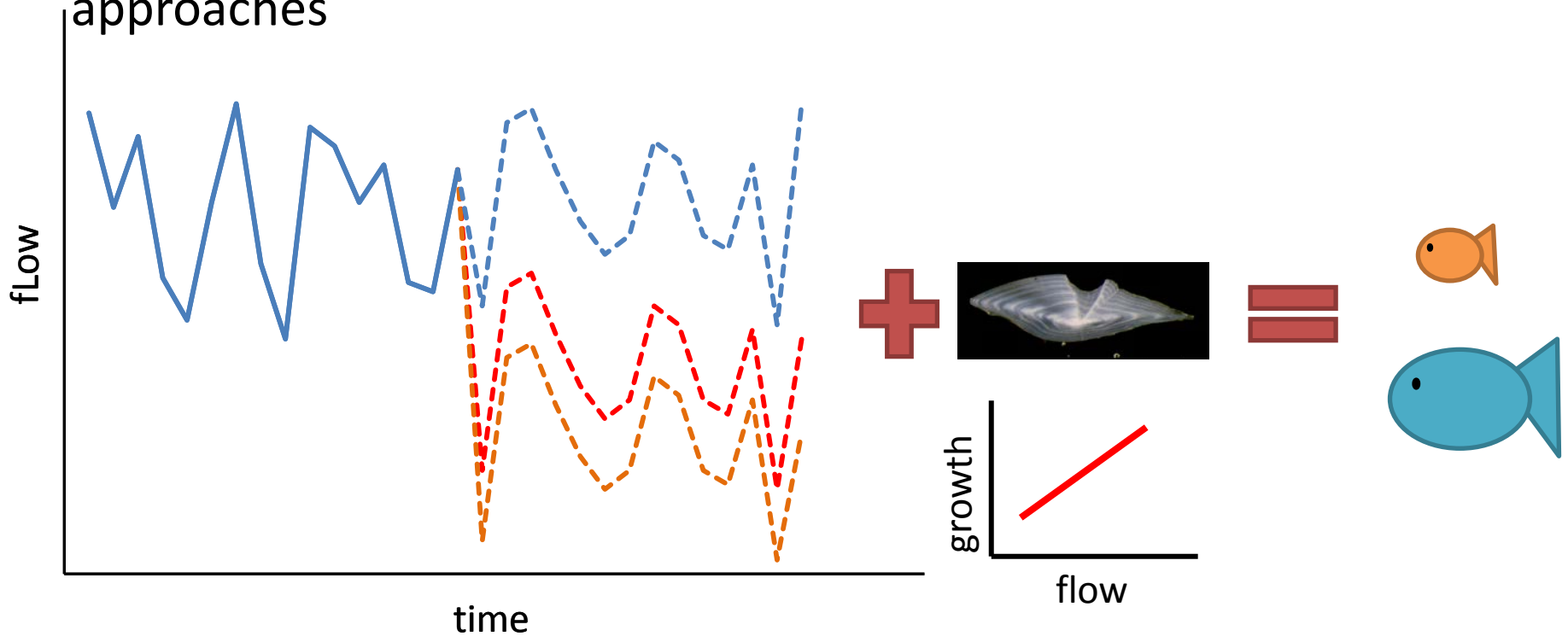
Otolith collections already exist- cheap sampling

Benefits

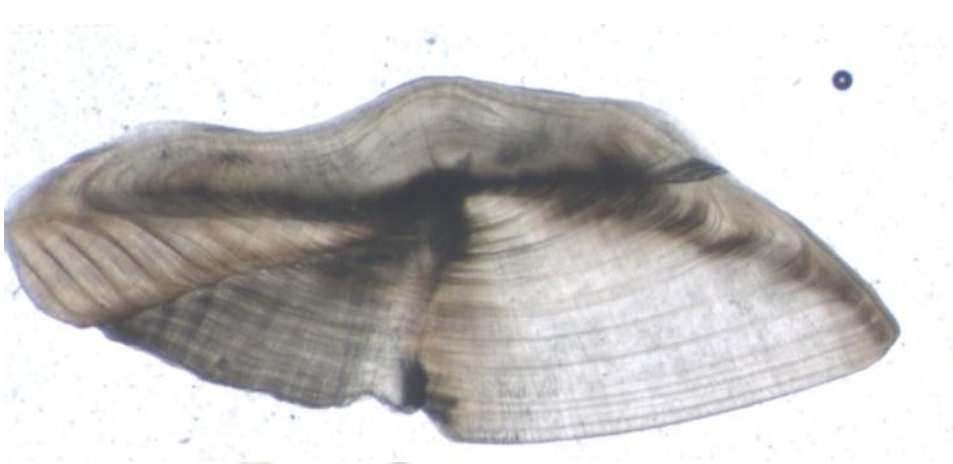
Strong biological relevance of fish growth and recruitment

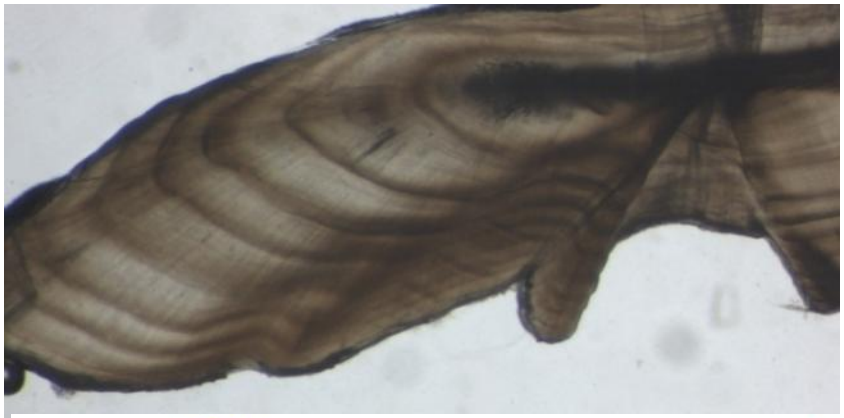
Predictive models: e.g., test impact of water extraction and river regulation scenarios; fisheries performance/ impacts

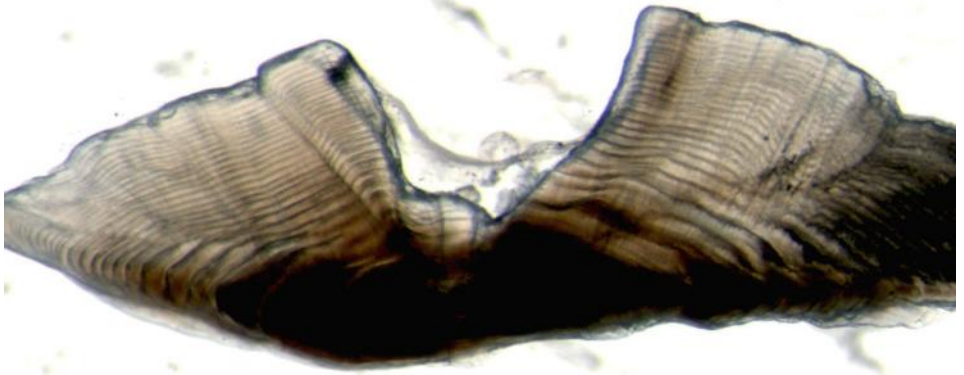
Key role in linking ‘pattern to process’- complementary to other approaches

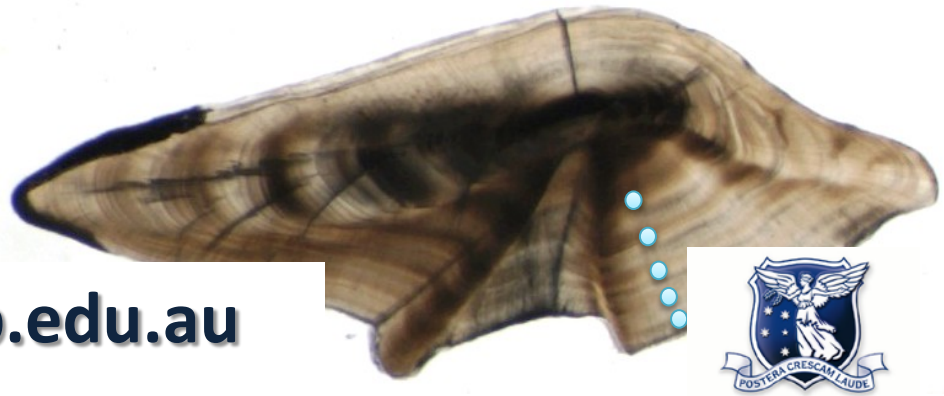


Thank you









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Black bream

Recruitment driven by estuarine stratification

Low flows in spawning season important

Jenkins *etal* (2015) *Marine Ecology Progress Series* **523**: 125-144