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

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Monitoring in Northern Australia
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

Ray Hall
Fish are a key biological indicator

Social, cultural, and economic value
Play essential ecological role in aquatic environments
Sensitive to a range of 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

temperature
food web changes
river flow
fisheries

Estuary perch
Flow and temperature driven recruitment and growth dynamics

20: 1844-1860
Recruitment

Collected otolith samples across years

High flows in spawning season important for recruitment
Growth

46 year growth time series

Growth

Biology is complex: traits respond to multiple and changing drivers
Models for prediction, e.g. response to flow changes

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 et al. (2015) Marine Ecology Progress Series 523: 125-144