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Sound and Sharks, Investigating Detection from Different Directions:

Detecting sharks – Detecting humans

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SHARC I: Sonar detection and classification of sharks

SHARC II: Acoustic signatures of beach goers

Background to this work

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- 2012 – Several encounters and fatalities prompted WA Government (Applied Research Program) funding "SHARC"
- 2013 – CMST with Mullaloo (MSLSC) members awarded research grant:
  Feasibility of shallow water sonar shark detection.
  If a suitable system existed, develop algorithms to detect sharks
  Estimate potential environmental impact.
- 2014 – MSLSC acoustic tag receiver array to detect tagged sharks
  – Curtin/MSLSC initiate MOU "BeachLAB" as a platform to scientifically test Beach Safety Management Technologies (Initially shark orientated)
  - CMST with Mullaloo (MSLSC) members awarded SHARC II grant:
  Characterise acoustic signatures of water-based activities as a potential cue for sharks
- 2016 –"SHARC" project outcomes
  Current systems limited range in shallow water
  Laid out specifications for 'optimum' shark detection sonar
  Laid out experimental procedures to test performance and impact
- 2017 – Seeking funding to progress this (discussions Shark Mitigation Systems)

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Overview: Two Projects

- **Acoustic signatures of beach goers as a potential cue for sharks:** Characterise sounds produced by humans during different water-based activities and assess if they may be detected by sharks.
  - Background (sound pressure, particle motion and fauna hearing)
  - Typical coastal underwater sounds (mechanical)
  - Human-powered activities (swimming, kayaking, diving)
  - Playback tests

- **Sonar detection and identification of sharks:** Assess feasibility of using sonar to detect sharks using off-the-shelf systems. If so, develop detection algorithms and assess the likely environmental impact
  - Brief history of sonar and sharks
  - Initial studies in 2013, short range detection
  - Shark Bay tests
  - Environmental impact

Take home message: Sound cues

- Quantifying human signals and contribution to the local soundscape is relatively simple.
- Human-powered signals are audible, considerably quieter than mechanical noise, likely audible over tens of metres.
  - Useful for evaluating swimmers performance
- Signals are complex, as would be masking them.
  - Highly variable (35-40 dB variation between 5th and 95th %iles)
- Accurately quantifying sound pressure and particle velocity in confined spaces is complex and varies considerably with frequency – Requires significant knowledge of acoustics (physics).
- Potential error for quantifying hearing thresholds, need to understand the properties of the sound field.
- CMST making progress. https://www.youtube.com/watch?v=aQx3QWbf5aI
  - https://www.youtube.com/watch?v=EO4q_ua0Gbw

Take home messages: SONAR

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- Short range – Easy bit!
- Longer range (>60 m – Not so easy >100 m the next challenge)
- Several detections at various ranges (in near perfect conditions)

  RANGES USEFUL FOR BEACH MANAGEMENT
- Tested a number of sonar systems – No single one is ideal
- Proposed set of specifications!!!!! Additional mechanisms to test
- Classifiers: We have series of descriptors to integrate into previous size, speed classifiers.
- Test version (funding)

  – Long-term performance – BEHAVIOURAL IMPACTS

- Future issues to tackle: Automation – probabilistic detection….

  What is the safe percentage?

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Thank you for listening.

Questions? miles.parsons@curtin.edu.au

Support gratefully received

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Ocean Park Aquarium Shark Bay

Shark Bay Ecosystem Research Project

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