Identifying nocturnal bird calls

Presentation at the Department of Conservation, Christchurch

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5 June, 2014

Executive summary: not yet useful for Tier-1 monitoring

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Data Science

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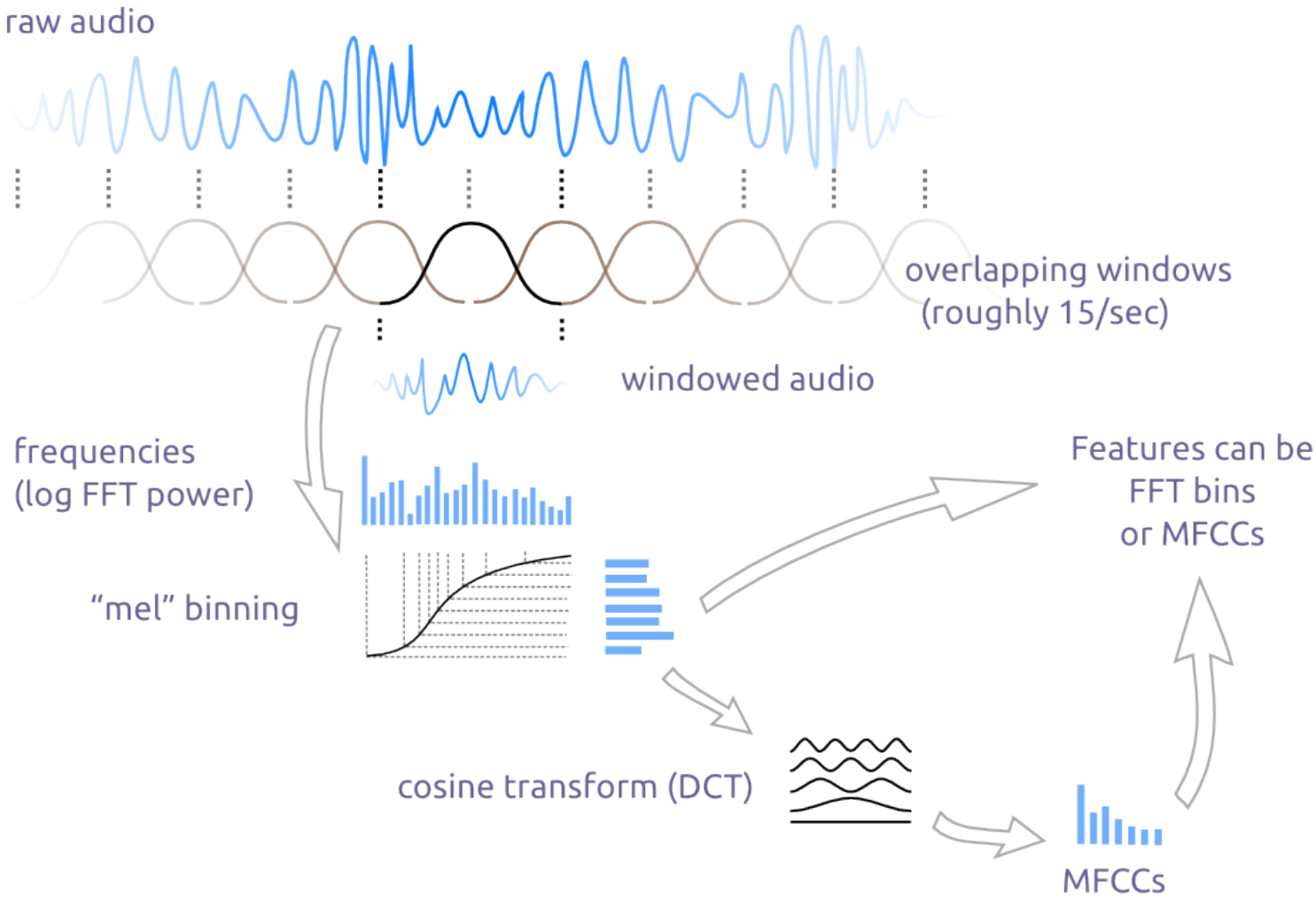
Goals

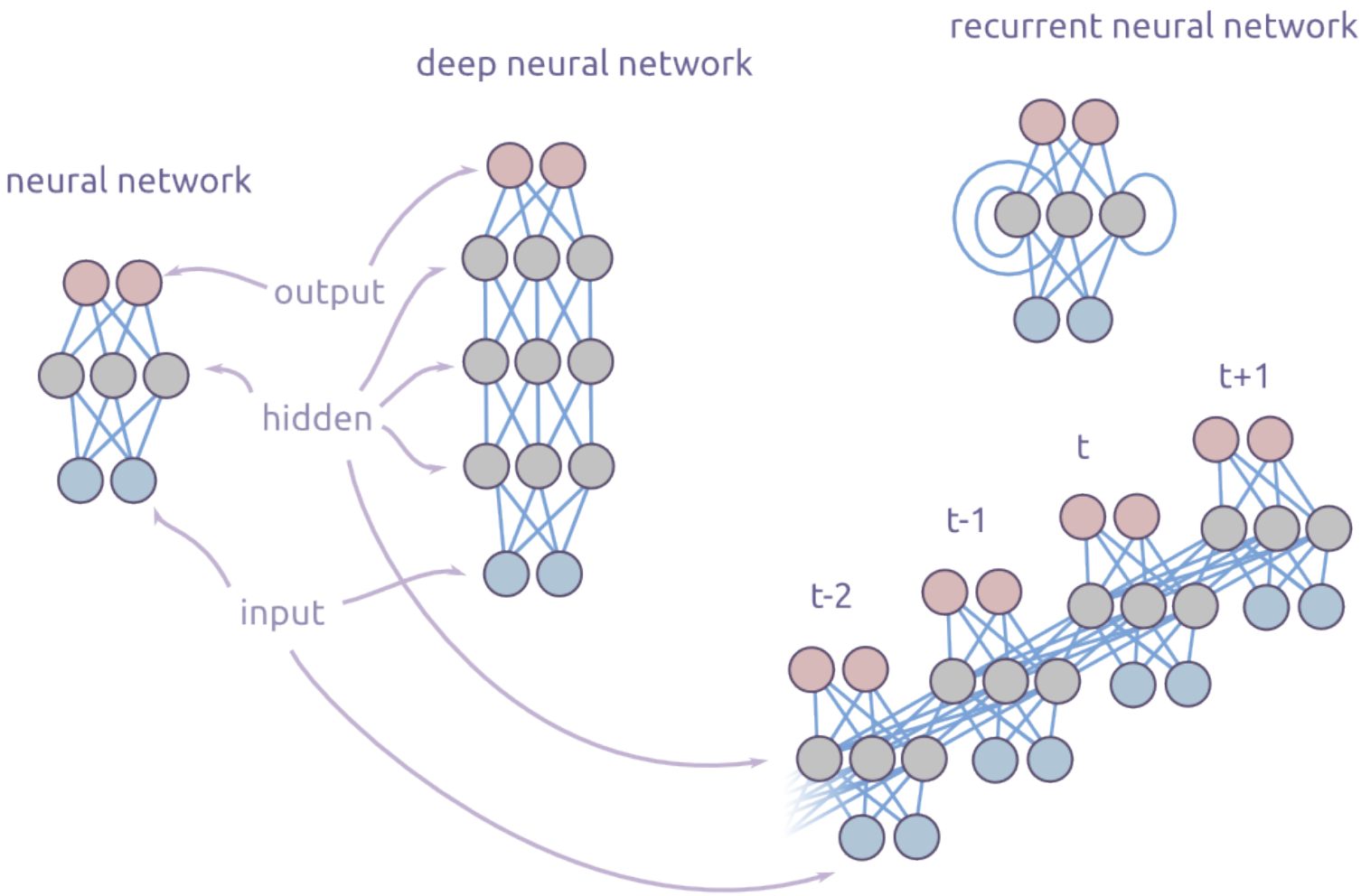
- Identify kiwi, morepork, and weka in nocturnal recordings
- Allow recordings to be ignored that are unlikely to contain calls to reduce the effort needed to score calls
- Facilitate consistent, automated monitoring of acoustic data from around New Zealand

Recurrent Neural Networks

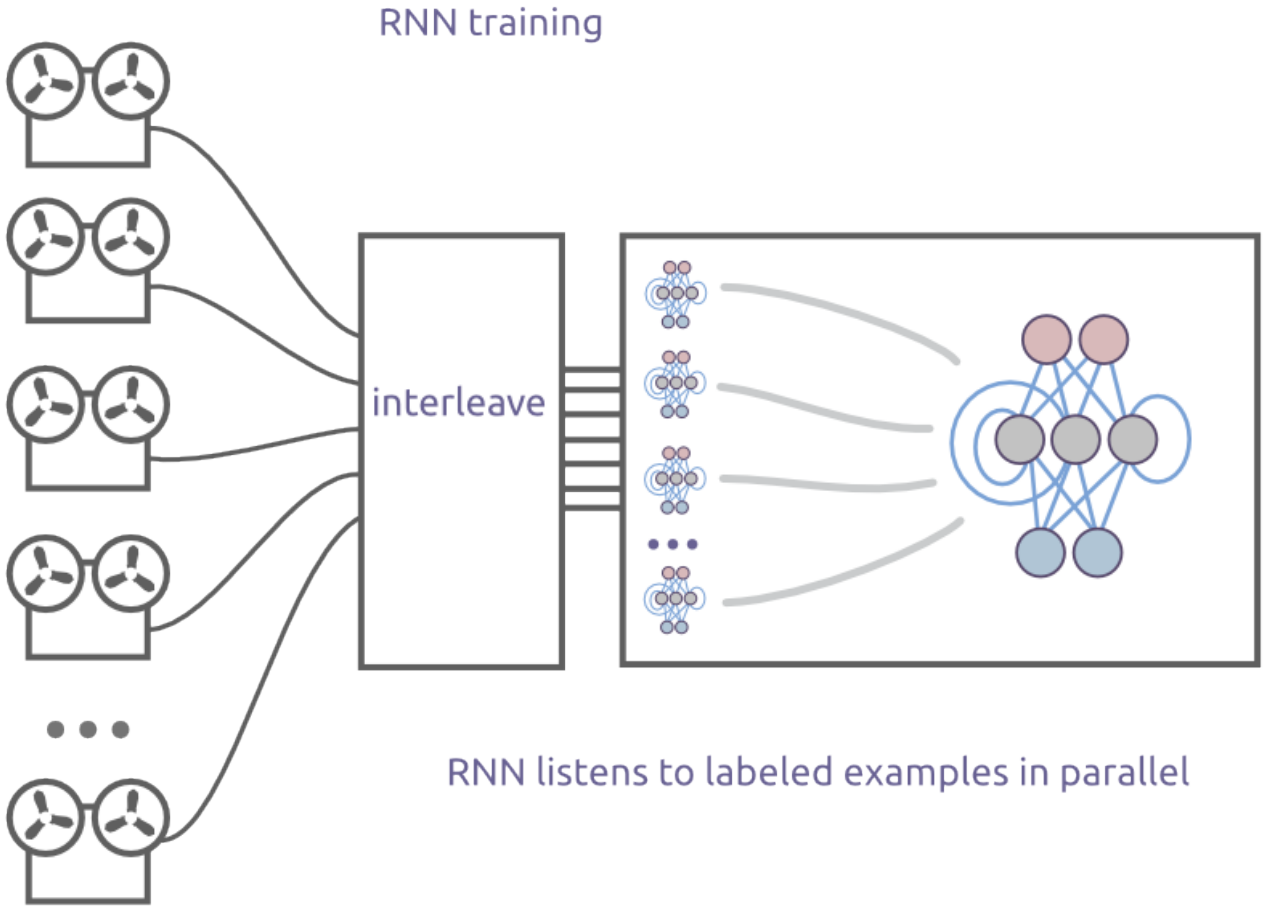
Audio processing



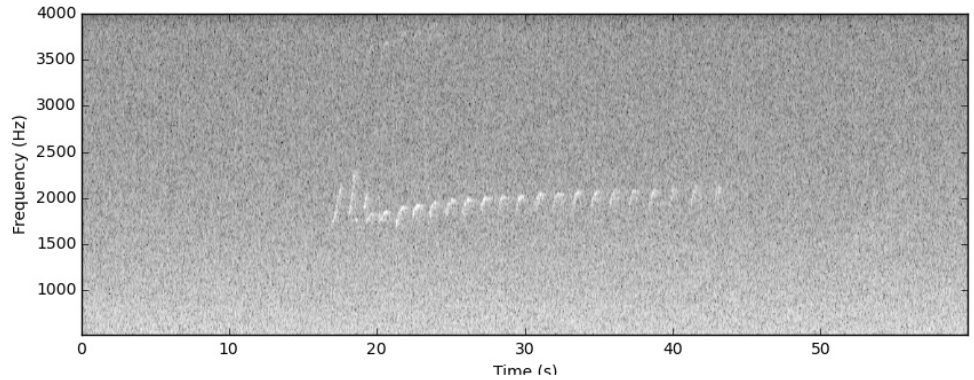
Recurrent Neural Networks

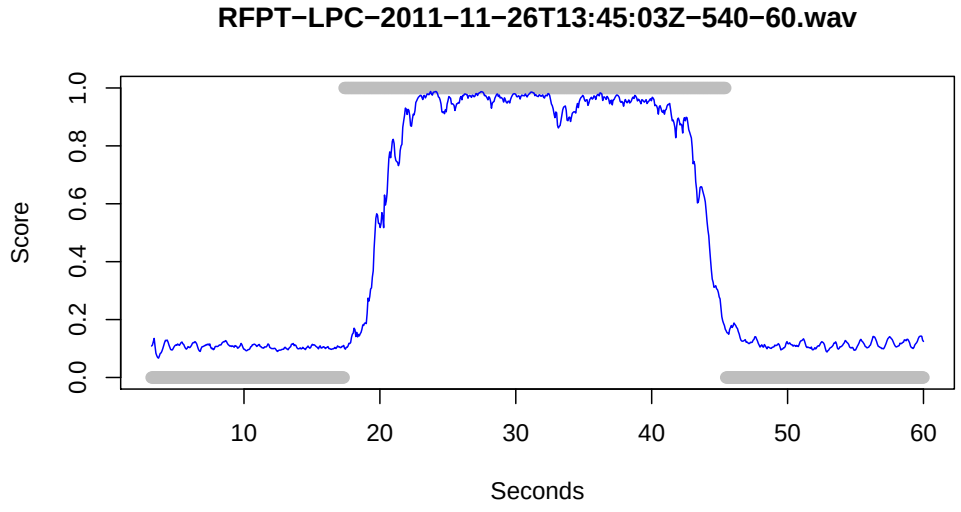


Parallel processing



An example prediction





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Identifying kiwi

Training data

- Provided with 2439 15 - minute audio files from the Tier - 1 data set
- First calls of each bird species in each file labelled using Freebird
- A total of 1327, 183, and 103 files containing kiwi, morepork, and weka, respectively

Files with kiwi in the Tier - 1 training set

species	2011–12	2012–13
brown / tokoeka	78	34
great spot	28	21
little spot	0	3
spp	0	19
total	106	77

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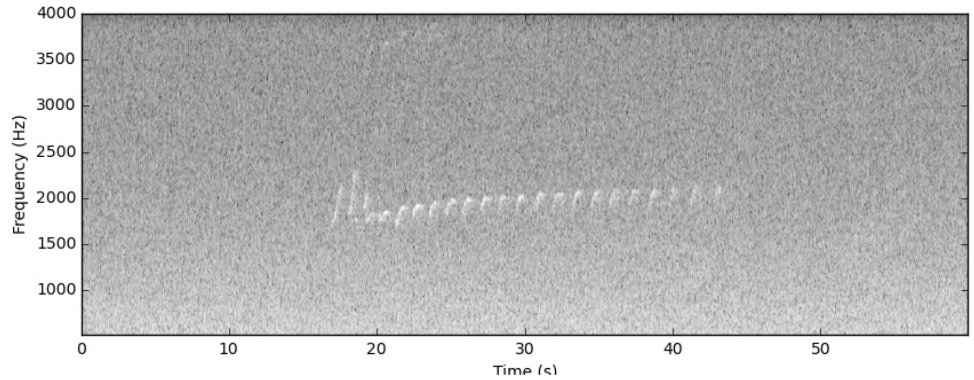
Training data

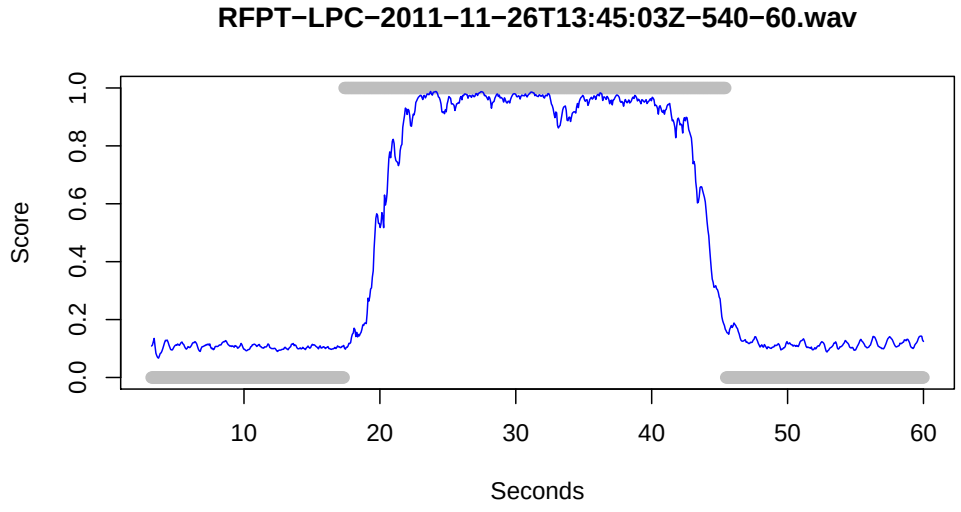
- Requires a well - labelled training set
- Current Tier - 1 protocol not ideal for three reasons
  1. For kiwi and weka, there were insufficient examples in the training data
  2. not all calls are labelled
  3. time bounding of calls isn't precise
- Carried out our own labelling of morepork calls
- Used data from the Rimutaka Forest Park Trust for kiwi

Rimutaka kiwi

- Data from the Rimutaka Forest Park Trust
- 20 444 1 - minute clips
- Half of the clips with high energy in the kiwi frequency
- Half of the clips randomly sampled from the remaining 600 000 clips
- Added in 6870 1 - minute kiwi - less clips from the Tier - 1 set
- Held out 2500 clips as a test set

A successful prediction





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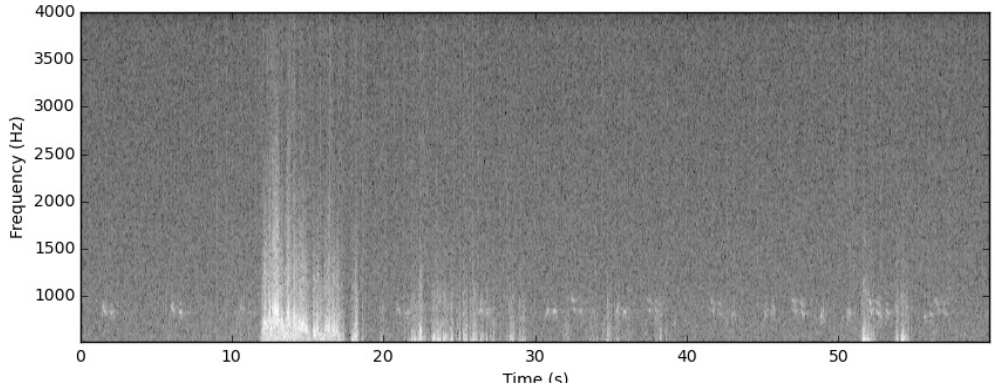
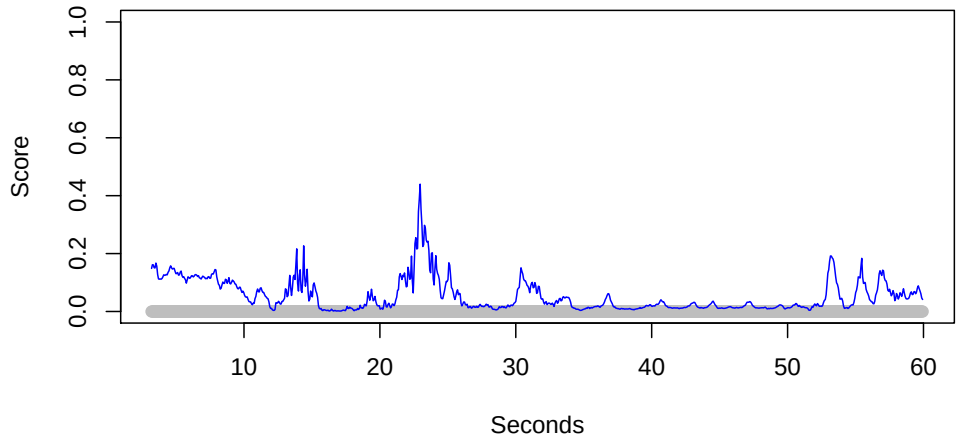
No kiwi here



RFPT−LPA−2011−12−25T16:45:02Z−120−60.wav



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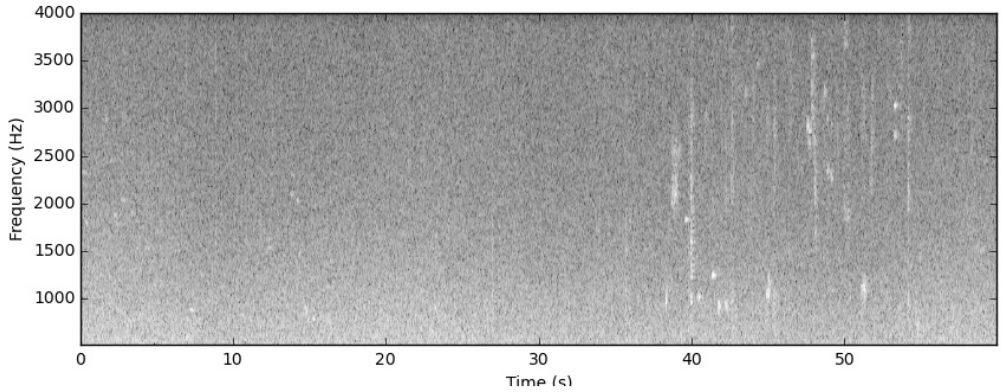
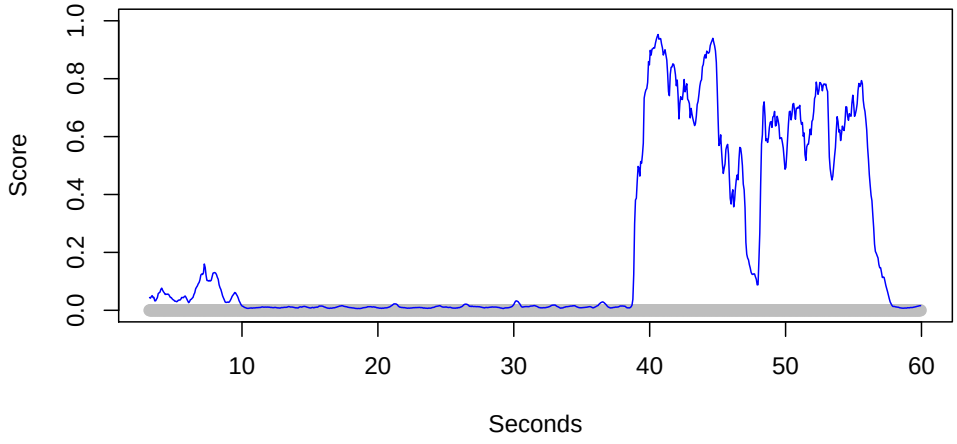
This tūi might be a kiwi



RFPT−SG2−2012−03−16T22:45:03Z−660−60.wav



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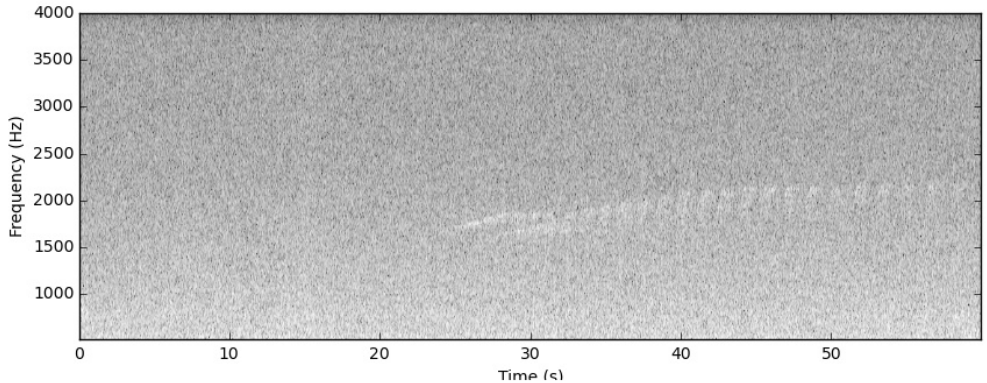
And it didn't find this call



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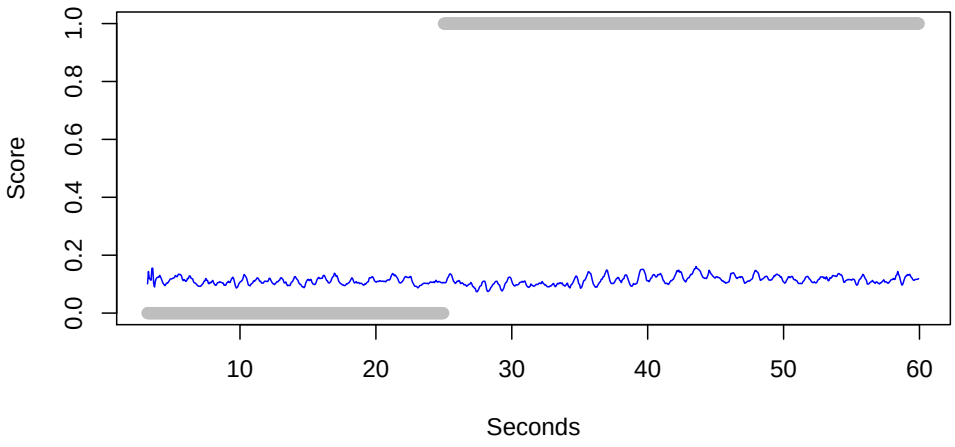

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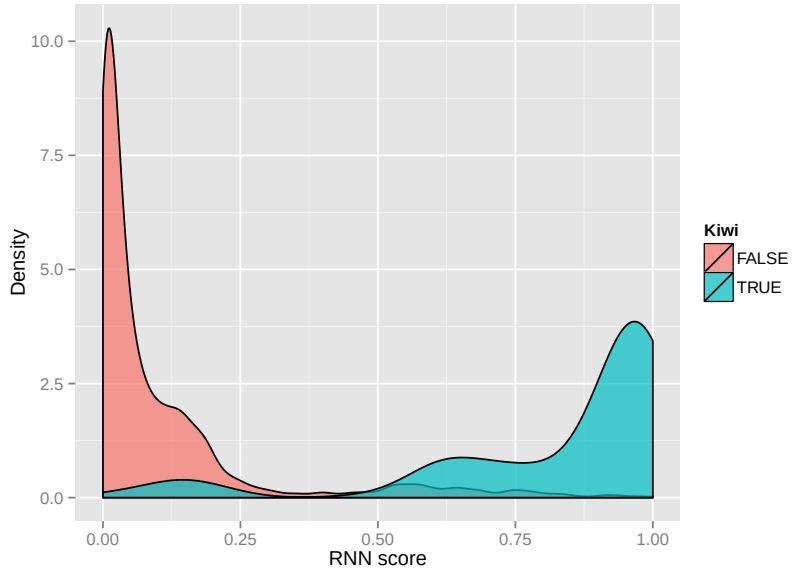
Kiwi RNN applied to test data

An AUC of 96%



	Score below 0.4	Score above 0.4	Correct (%)
No kiwi	2168	187	92.0
kiwi	12	133	91.7

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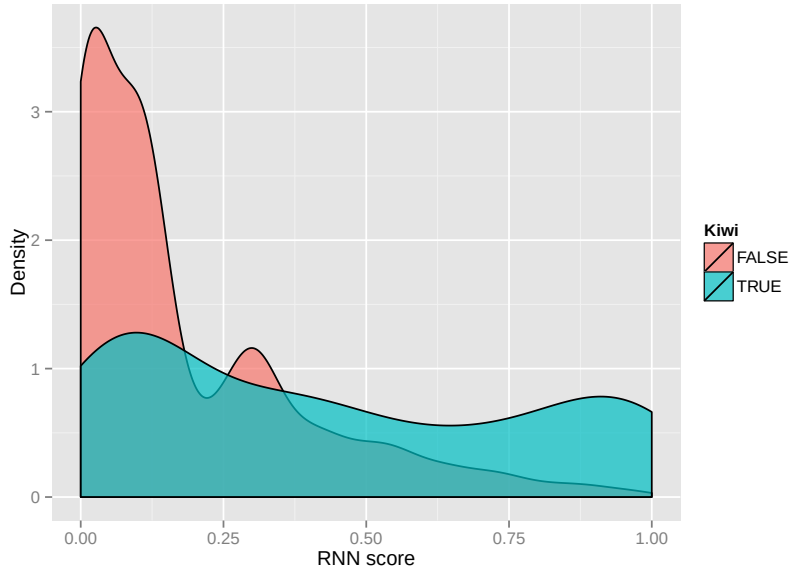
Kiwi RNN applied to Tier-1 data

An AUC of 71%

Not useful for discriminating kiwi in the Tier-1 data set



	Score below 0.4	Score above 0.4	Correct (%)
No kiwi	1907	338	84.9
kiwi	82	71	46.4

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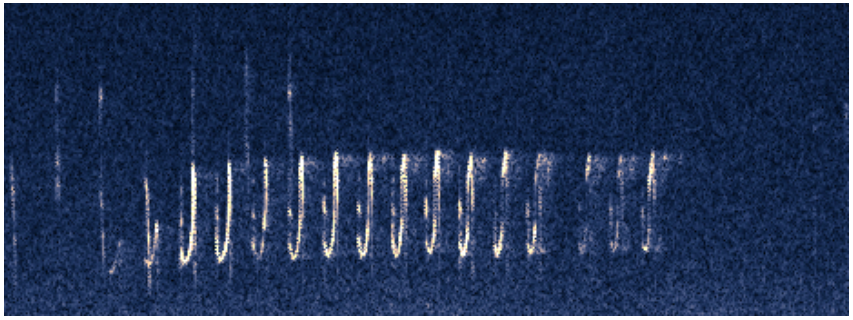
What has gone wrong?

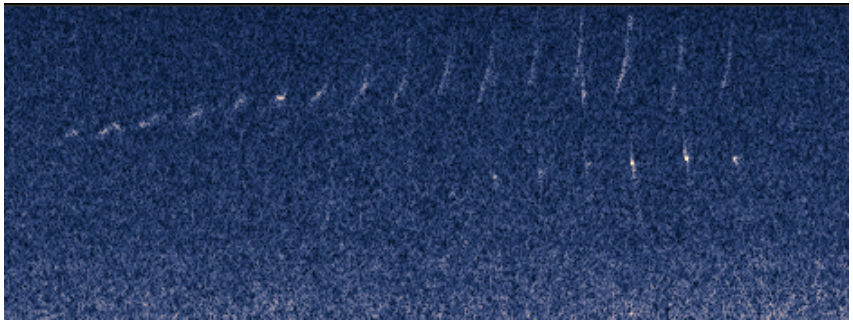
- Multiple kiwi species in Tier - 1 data set
- Greater diversity of background sounds
- More possibility of mistakes in 15 - minute data

Difficult to distinguish kiwi and weka

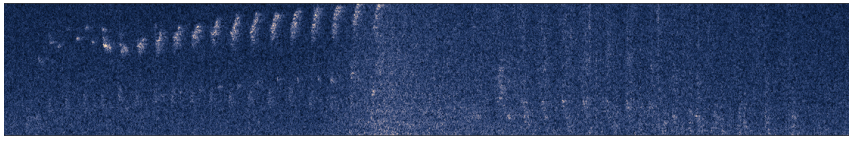
Weka



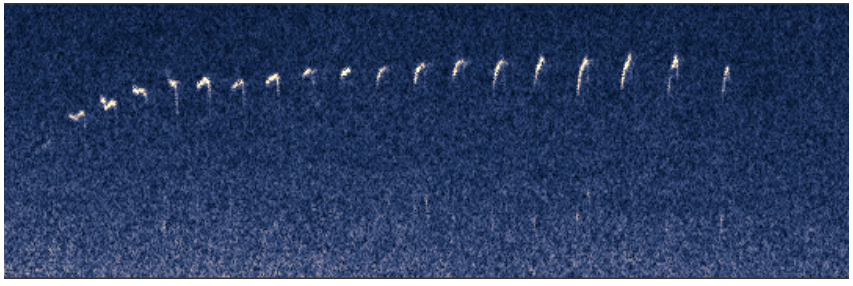
Weka sounding like a kiwi



Labelled in Freebird as kiwi - weka duet



Labelled in Freebird as weka



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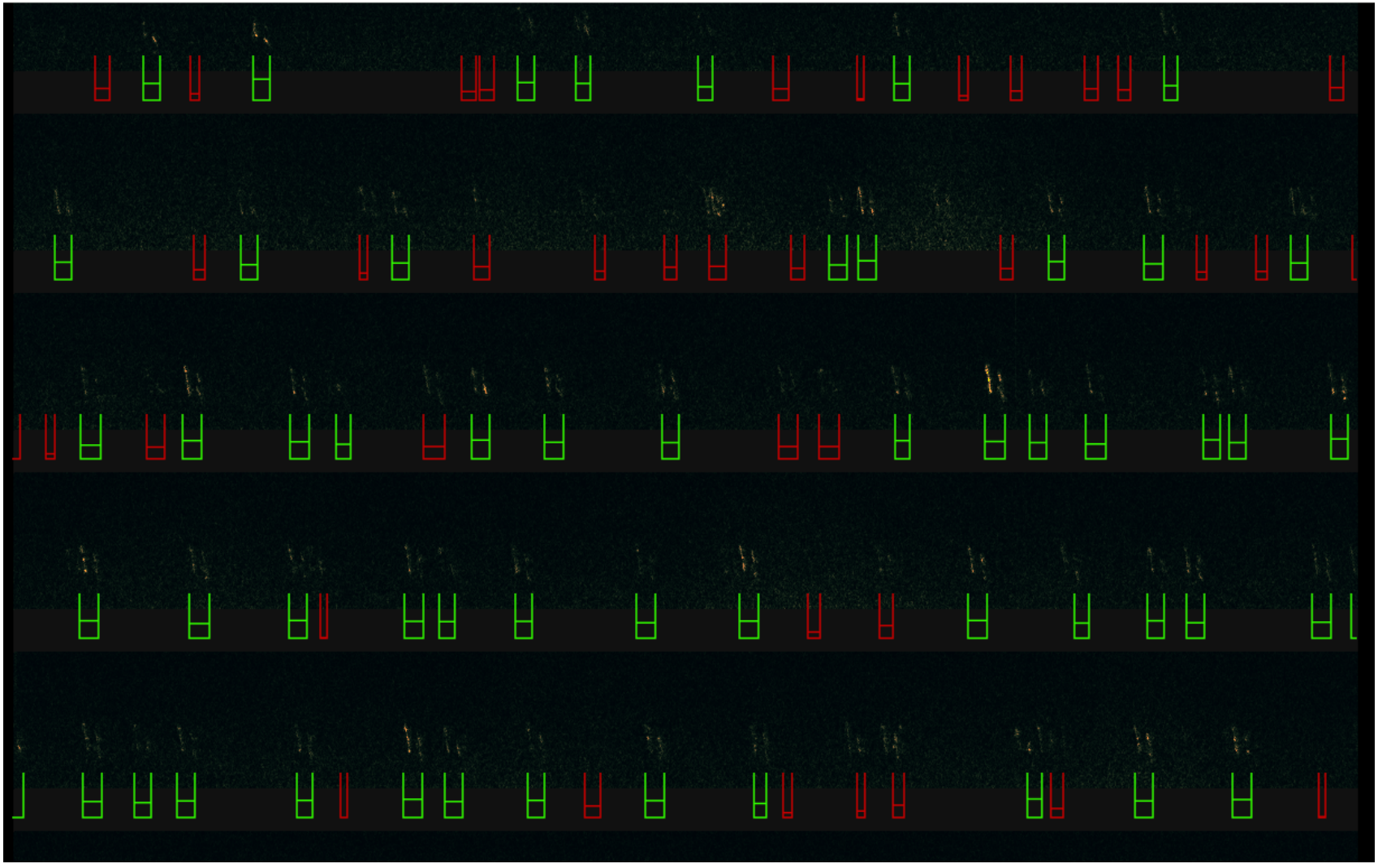
Identifying morepork

Morepork calls

- Use the first minute of each Tier - 1 file, and the rest of ‘interesting’ files
- Count any morepork call type (ruru, quee, etc.) as a morepork
- Extend data by changing the levels, and blending known morepork with a range of background noise
- A total of 16 146 labelled minutes, 7938 with morepork
- A total of 26 651 calling periods

Finding morepork calls



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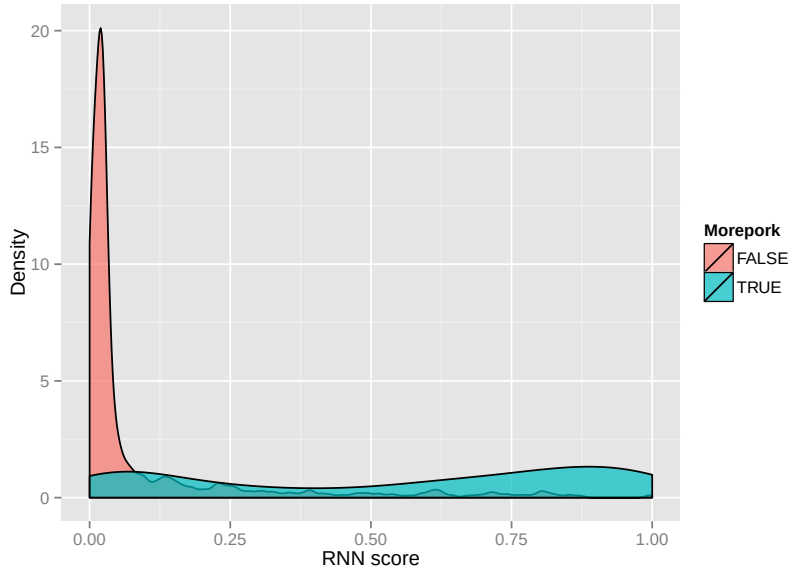
Morepork RNN applied to test data

An AUC of 88%



	Score below 0.2	Score above 0.2	Correct (%)
No morepork	1703	281	85.8
Morepork	151	365	70.7

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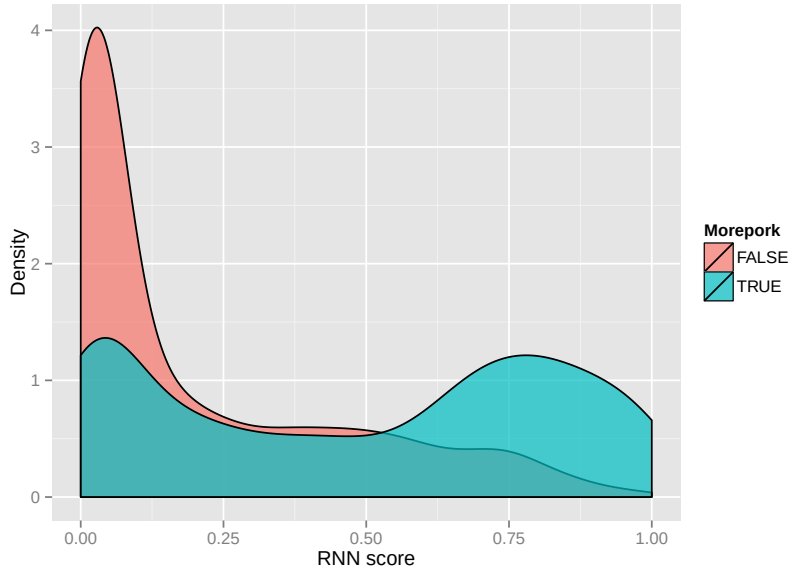
Morepork RNN applied to Tier-1 data

An AUC of 74%

Not useful for discriminating morepork in the Tier-1 data set



	Score below 0.2	Score above 0.2	Correct (%)
No morepork	877	398	68.8
Morepork	393	730	65.0

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Morepork RNN

- Classifier not as accurate on 1 - minute training hold - out clips as kiwi
- Morepork are harder as the individual calls are shorter
- Perhaps there are difficulties with the diversity of calls, and wide variation in intensities
- Performance degrades as the interval is extended to 15 minutes

Summary

- Recurrent Neural Networks not yet suitable for automating Tier-1 acoustic monitoring
- To improve would require specialised training data (calls well-located in time, and with large numbers of cases)
- May need other modelling methods (e.g., Random Forests) to go from continuous score of the RNN to a classification of the audio file
- Positively, the RNNs will be useful for finding infrequent kiwi calls at sites similar to the Rimutakas