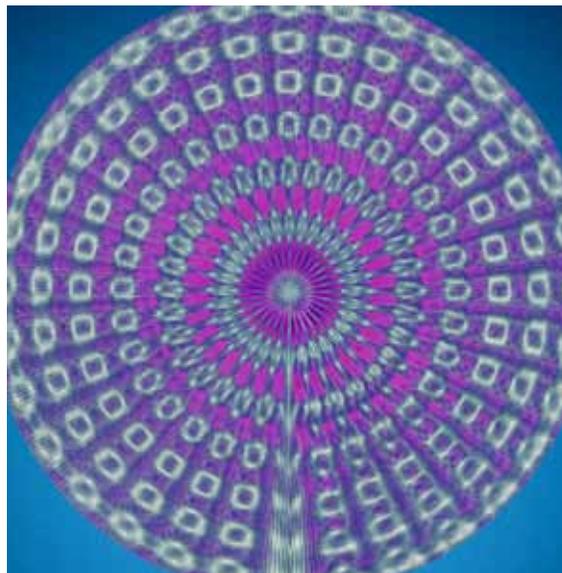
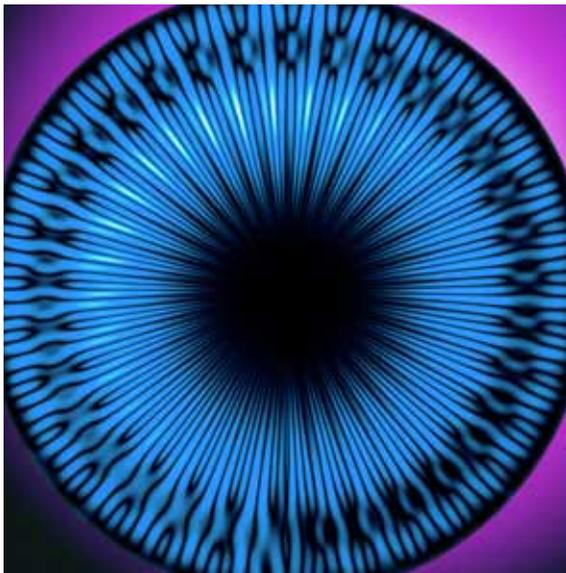


Whale Song Art

These exquisite images are the visual representations of songs sung by whales and dolphins. The sounds were recorded by US engineer Mark Fischer and transformed into visuals by clever mathematics. But these are not just pretty pictures - the patterns reveal tantalising clues to how these majestic animals communicate through song.



Fischer worked on US Navy sonar and software for defence and aerospace companies. But he changed career when he joined a field group following pods of Blue whales: "Anyone who has a chance to be in the ocean with whales or dolphins knows immediately that it is an extraordinary thing," says Fischer. "There is just something about them. You can't quite put your finger on it, but you sure do feel it." Whales and dolphins are a group of animals known

as cetaceans. Most of them produce a wide range of audible whistles, clicks, moans and cries. But some species take this form of communication to a much deeper level. The Blue and the Fin whale, respectively the largest and second largest animals on the planet, are able to produce sound frequencies in the range of 10 to 20 Hertz, well below the human range of hearing (20 Hz to 20 KHz). In order to capture these sounds, marine biologists use special



underwater microphones known as hydrophones.

Fischer realised that the standard method of interpreting whale songs – using spectrograms of frequency plotted over time – were not providing a full picture of their intricacies. So he turned to a branch of mathematics known as wavelets. This tool allows a deeper analysis of frequencies in sound – or any

other - waves. When Fischer applied wavelets to whale song spectrograms, he was able to see structures in the frequencies that were not visible in normal spectrograms: "To look at a spectrogram you will see a simple, boring blur with a few harmonics," he says. "With wavelets, however, there was an image that displayed extraordinary structure. Something was going on



with this sound, even if we are not quite sure what."

The images that result from wavelet transformations are certainly spectacular. The Minke whale image, for example, was based on a recording of the sound it makes, known as a 'boing'. A spectrograph would show little structure in this noise, but when converted by wavelets, the graph reveals a dense level of structure in the sounds. The effect

is even more apparent when colour is applied and the graph transformed from rectangular to polar coordinates, forming a circular graph that Fischer likens to the eastern religious symbol called a Mandala.

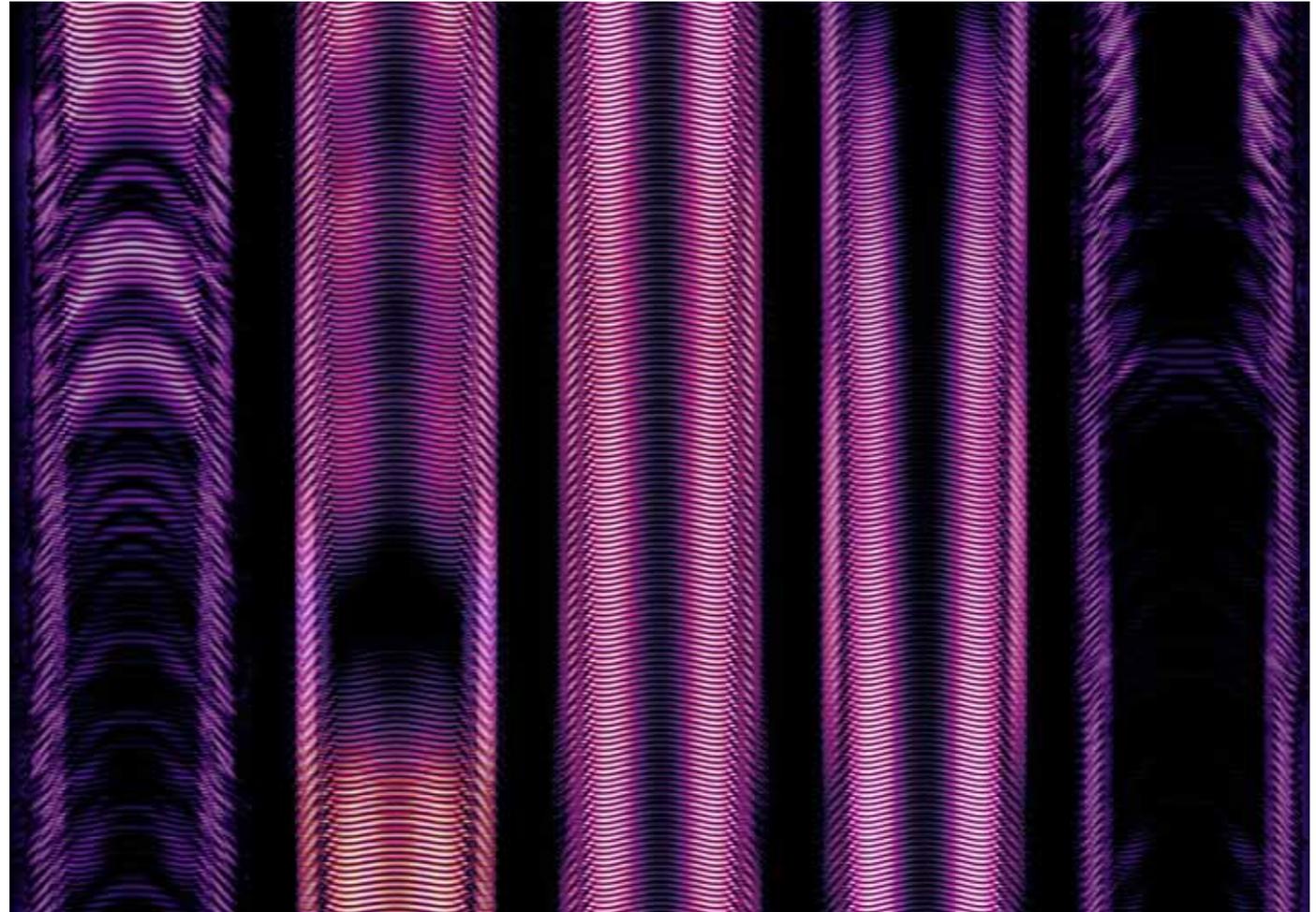
Although Fischer has worked on the recordings of a wide variety of cetaceans and even birds, he has a special fascination for the songs of the Humpback whale:

"Take a look at a wavelet graph of a Humpback song and you get much more of an impression of structure, of composition, of feeling, of intention. They are astonishing in the range of structures and textures that are revealed - a veritable tapestry."

The singing ability of Humpback whales has long been known. But recent research shows that the songs differ in local dialects and contain complex grammatical rules, indicating a higher level of communication than first thought.

Fischer has exhibited his acoustic artworks all over the world. With increasing pressures on cetaceans, from pollution, over-fishing, shipping injuries and whaling, he hopes his work contributes in some way to our understanding of these amazing creatures:

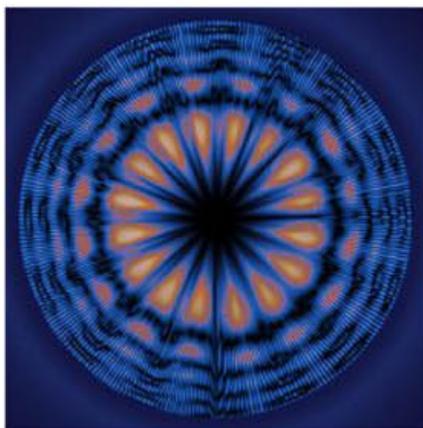
"With a little bit of investigation we may be able to show some evidence of 'culture' in a non-human species in ways that leave no doubt," he says.



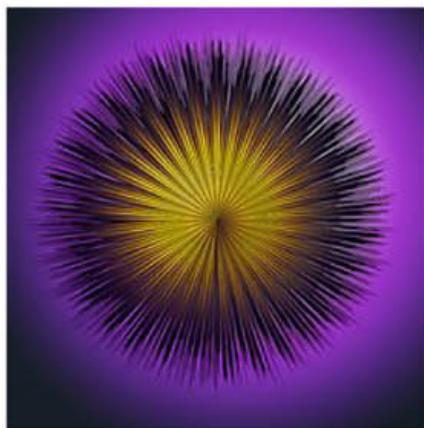
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Written by Seymour Yang

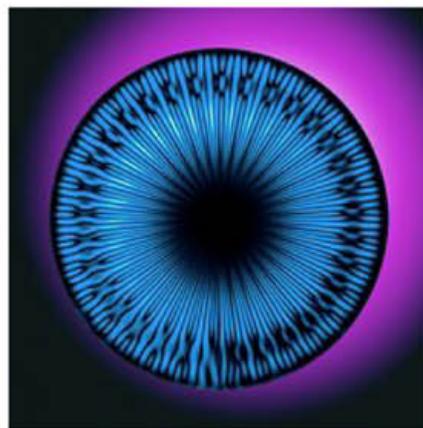
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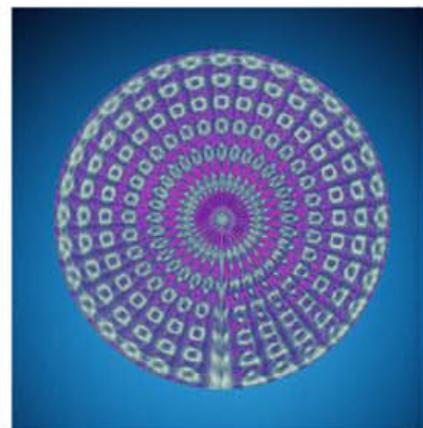
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Humpback whale song, wavelet graph



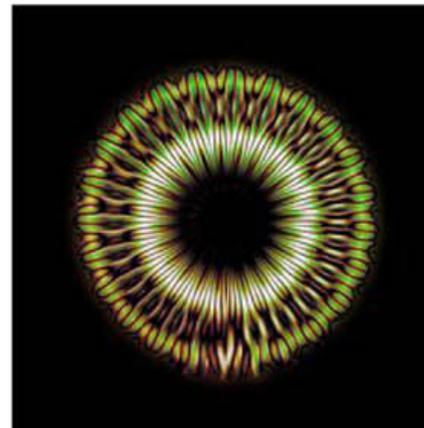
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Humpback whale song, wavelet graph



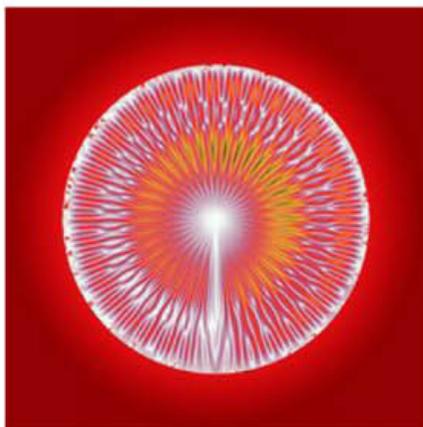
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Humpback whale song, wavelet graph



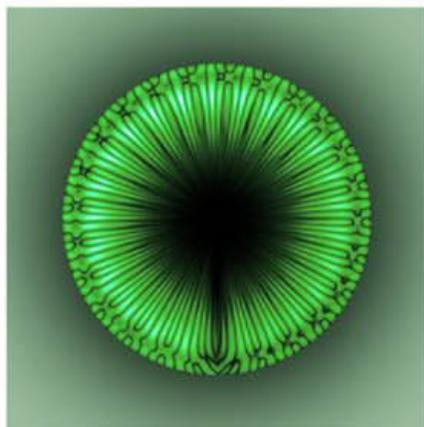
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Minke whale song, wavelet graph



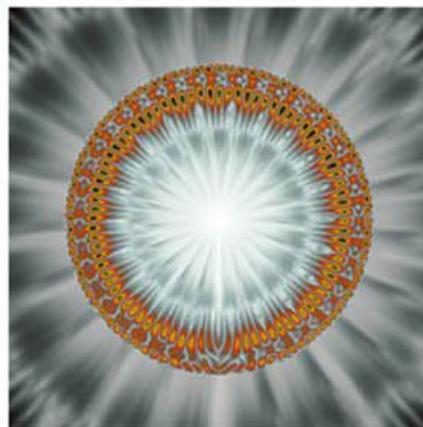
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Humpback whale song, wavelet graph



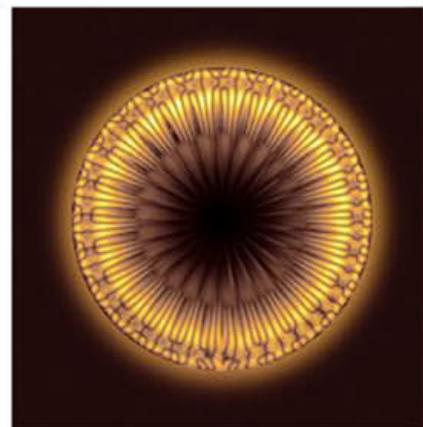
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Humpback whale song, wavelet graph



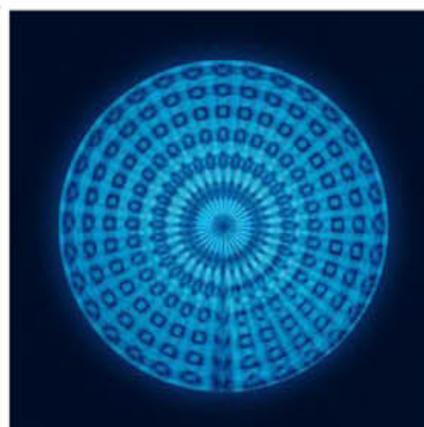
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Humpback whale song, wavelet graph



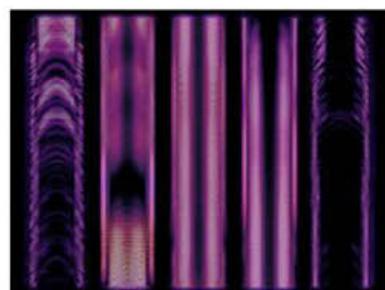
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Humpback whale song, wavelet graph



Z920/0354
Humpback Whale song, wavelet graph



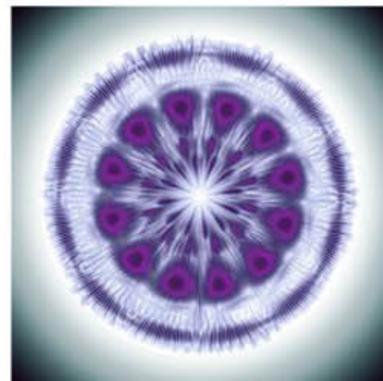
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Minke whale song, wavelet graph



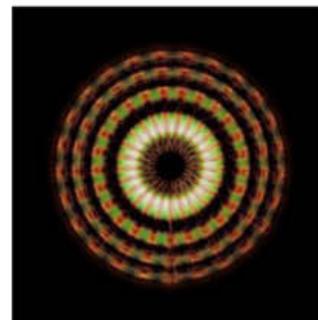
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Humpback whale song, wavelet graph



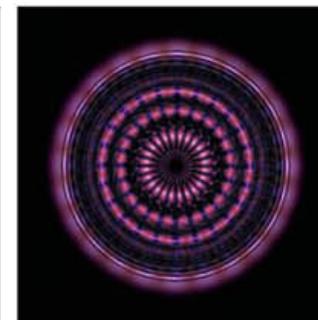
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Minke whale song, wavelet graph



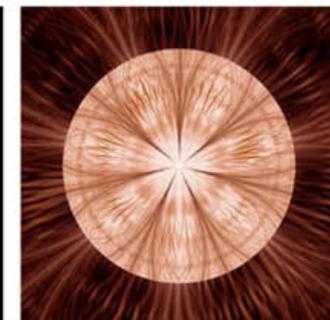
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Minke whale song, wavelet graph



Z920/0360
Minke whale song, wavelet graph



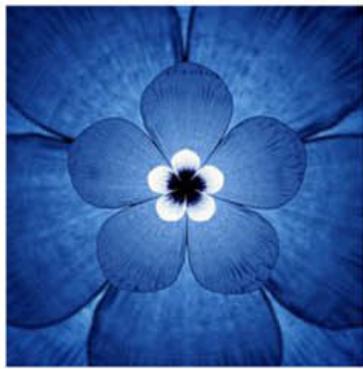
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Minke whale song, wavelet graph



Z920/0362
White beaked dolphin sound frequencies



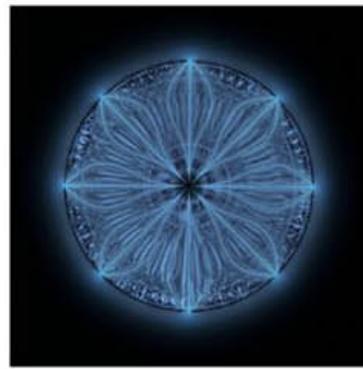
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White beaked dolphin sound frequencies



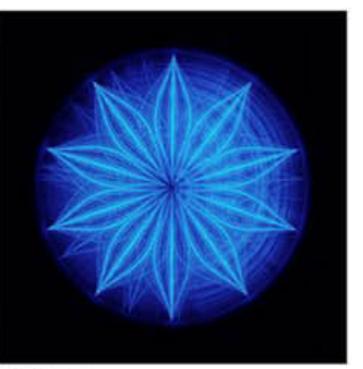
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White beaked dolphin sound frequencies



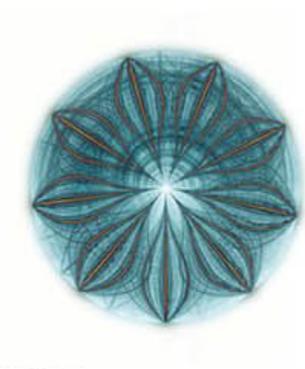
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White beaked dolphin sound frequencies



Z920/0367
White beaked dolphin sound frequencies



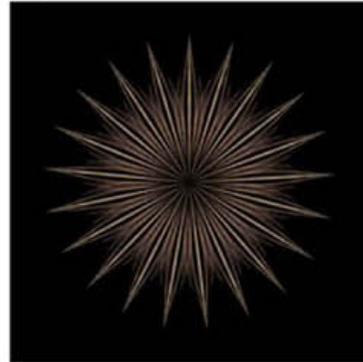
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Atlantic spotted solphin, wavelet graph



Z920/0373
Atlantic spotted solphin, wavelet graph



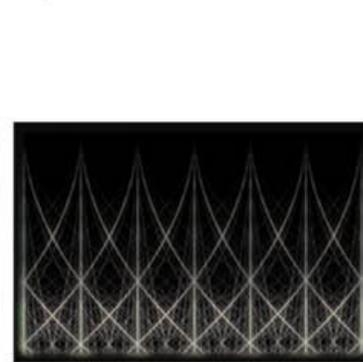
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White beaked dolphin sound frequencies



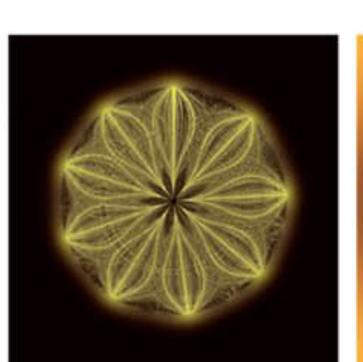
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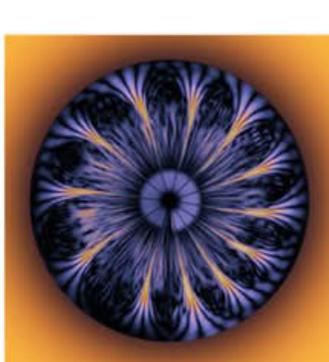
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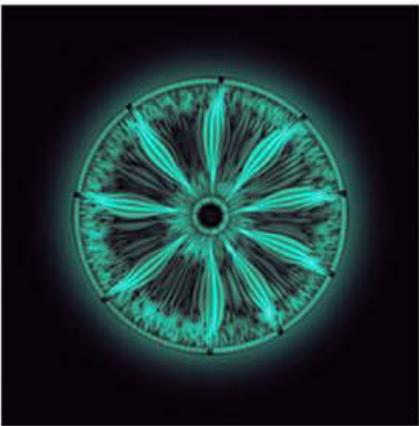
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White beaked dolphin sound frequencies



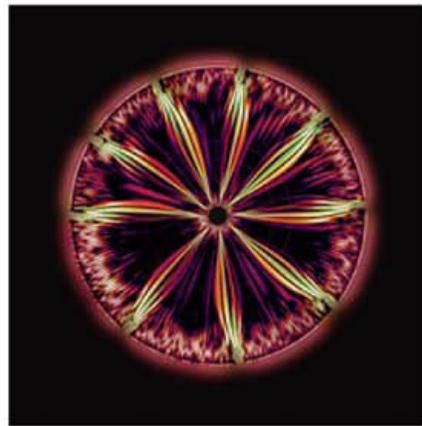
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Atlantic spotted solphin, wavelet graph



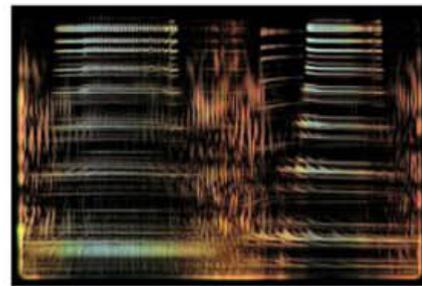
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False killer whale sounds, wavelet graph



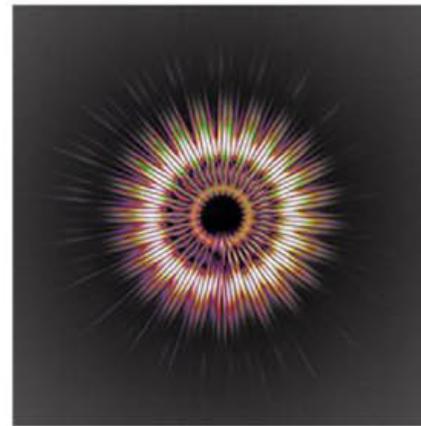
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False killer whale sounds, wavelet graph



Z920/0377
False killer whale sounds, wavelet graph



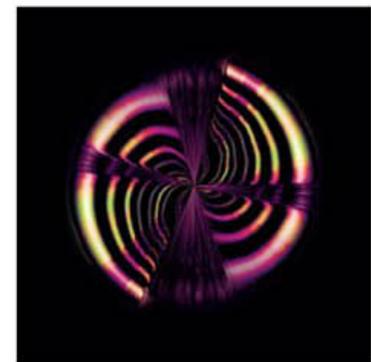
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Blue Whale song, wavelet graph



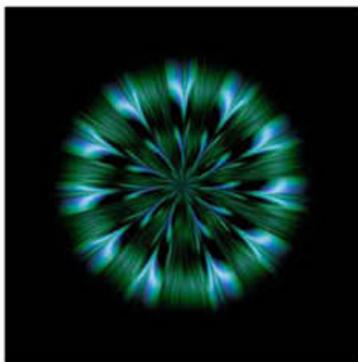
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Humpback whale song, wavelet graph



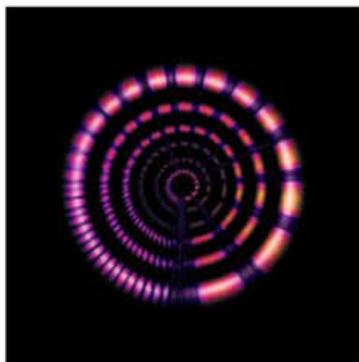
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Northern cardinal



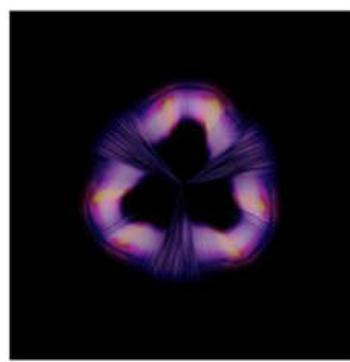
Z892/0847
Northern cardinal song, wavelet graph



Z892/0848
Chipping sparrow song, wavelet graph



Z892/0849
Cassin's sparrow song, wavelet graph



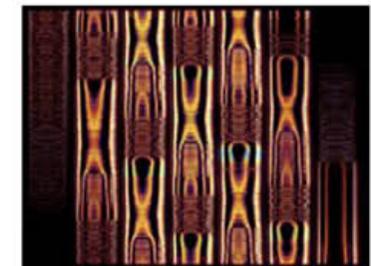
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Bird song, wavelet graph



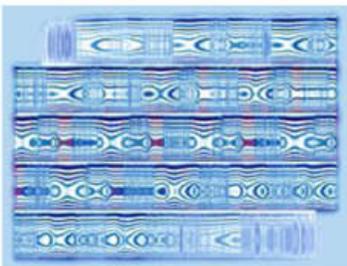
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Spotted dolphins



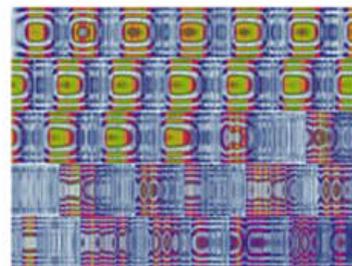
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Atlantic spotted dolphins



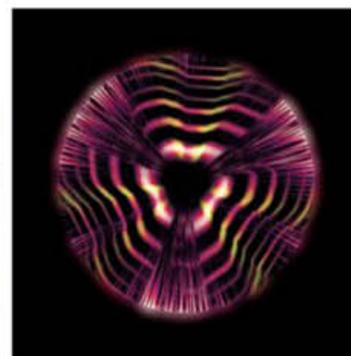
Z892/0850
Amakihi bird song, wavelet graph



Z892/0851
Akekee bird song, wavelet graph



Z892/0852
Fairy wren song, wavelet graph



Z892/0853
Bird song, wavelet graph



Z920/0160
Humpback whale



Z920/0191
Humpback whale mother and calf



Z920/0192
Humpback whale mother and calf



Z920/0246
Minke whale head



C0013669

Feature Story 1224
Whale Song Art
48 high res images
600 word article

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