

## To Wail With a Whale: *Anatomy of an Interspecies Duet*

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### ABSTRACT

A clarinet was played along live with a singing male humpback whale off a boat off the coast of Maui. A four and a half minute passage of the duet is visually analyzed using a sound spectrogram to demonstrate that the whale appears to alter his song in response to what the clarinet played. This observation is consistent with the fact that humpback whales rapidly change their song during breeding season from week to week, with all the male whales singing the same new song, even as it steadily evolves in a very short period of time. Interspecies music thus demonstrates that a male humpback whale is able to quickly match new pitched, musical sounds it has never heard before, a result different from most humpback whale playback experiments, where the whales have shown little interest in the sounds we play back to them, aside from summer feeding sounds played off-season in the winter. Perhaps they are more interested in music than we thought! If the whale was unable to match new and unfamiliar sounds, it is unlikely he could learn new songs as quickly as we believe they do. This result helps to confirm the reigning theory that humpback whales have a culture of song that changes steadily over the course of a single season.

### INTRODUCTION

The song of the humpback whale is the most extended patterned vocalization produced by any animal. These songs were first described in the literature by Roger Payne and Scott McVay, who took a bold step for scientific rhetoric when they praised the surprising beauty of these sounds in the prestigious journal *Science* in 1971. (Payne and McVay, 1971) During the following decades the astonishing moans of this whale made its way into human culture, becoming the inspiration for famous classical compositions by Alan Hovhaness, George Crumb, and later John Cage and Toru Takemitsu. In the pop world the humpback whale song and the plight of the whale found its way into works by Pete Seeger, Judy Collins, Captain Beefheart, Crosby Stills and Nash, Jethro Tull, Yes, Paul Winter, Charlie Haden, the Partridge Family, Country Joe and the Fish, Laurie Anderson, Alice in Chains, Tom Waits, and Lou Reed, to name but a few. The original recording assembled by Payne, *Songs of the Humpback Whale* became a platinum record, selling more than a million copies, and in 1979 an excerpt from it was included as a 'sound page,' in *National Geographic*. With more than

ten million copies printed at once in many languages, this remains the largest single pressing of any audio recording in history. (Rothenberg, 2008)

Humpback songs are far more musical in structure than the sound of any other dolphin or whale. They consist of repeating patterns, hierarchically organized at the level of unit (or motif), phrase, theme, and song. Each complete song consists of five to seven themes. Some of the phrases end with the same contrasting sound, so they can be said to rhyme, in a way analogous to human poems. A series of these songs can be repeated extensively, up to twenty-three hours in a single session. Only the male whales sing, and since singing mostly happens only during the winter breeding season, when the whales congregate in specific breeding grounds, such as the Hawaiian Islands, the Silver Bank off the Dominican Republic, and Archipelago Revillagigedo off of Mexico, it is generally assumed to be a male sexual display with the purpose of attracting females, who do not sing. However, no one has ever seen a female humpback whale show any interest in the song whatsoever, but other males do respond to a singing male, in a usually nonaggressive manner. A rival theory, less popular, but the only one with any evidence, says the humpback whale song serves to organize the male whales together in a manner different from any other animal we have yet observed. (Darling et al, 2006)

The most remarkable aspect of this amazing song is that, unlike nearly all bird songs, it constantly changes during the breeding season. When an innovation appears in the song, all other males strive to copy the new element and in a matter of weeks all are singing the same new song. They all want to sound the same, yet the sameness continually evolves. No one has postulated a good reason for this, and no one can yet explain why whales in any given ocean, say, the North Pacific, change their songs in tandem even though they are too many thousands of miles away to likely hear each other. (Cerchio et al, 2001) The whales in Hawaii and Mexico are changing their songs in tandem, in a similar way, even though they can't hear what the other population is doing. In birds, widely separated populations tend to have different dialects in their songs, but widely dispersed humpback whales have the same song, and they are changing it very rapidly in several ways. Again, no one can explain it.

Is the song of this whale really music? Does it deserve to be called a song? Humans seem to think so. Dario Martinelli conducted a blind listening experiment, letting fifty people listen to four pieces and decide whether each of them is music. The results were: 100% said Mussorgsky's "Pictures at an Exhibition" was music, 82% said a humpback whale song was music, 76% for Brian Eno's "The Shutov Assembly," and just 6% for "Alan's Psychedelic Breakfast," a notoriously abstract track from Pink Floyd. The whale song was chosen as the second most musical example by 80% of participants in the survey. (Martinelli, 2002) No surprise, really, since it is a formal construction, composed of repeating patterns and phrases clearly put together in a very organized way.

Of course humpback whale song did not evolve for human ears, so it may not make sense to test its musicality on human listeners, except to convince people that there is much more music out there in nature than they think. But there is another reason why animal songs are clearly comprehensible in musical terms, which is most familiar from the study of bird vocalizations: Birds have both calls and songs. Calls, which tend to be innate, are sounds with specific reference, such as "feed me!" or "get back," or even such specialized meanings as

“watch out, there is a hawk flying overhead!” Birds are born with the ability to understand sounds like these.

But bird songs are different: baby male birds must learn these phrases from adult males, most often in the first few months of their lives. These songs have a beginning, middle, and an end. In each species, the structure and form of these utterances are uniquely defined. They must be performed correctly to serve their supposed purpose: attracting mates or defending territories. These functions are the same for all species, yet the music the birds sing is different for each bird type. There is no meaning apart from a correct performance, you cannot translate bird song into any other language but itself. The meaning is in the precise performance of the piece, nowhere outside. It functions exactly the way music does. If it is sung incorrectly, the job is not done. (Rothenberg, 2005)

With its extended, clear structure, whale song is more clearly musical than the songs of most birds. And with the uncertainty about who the males are singing for, the song of the humpback whale is full of mysteries impenetrable to humanity. But for our species, a mystery means a challenge. One way we have tried to make sense of it is to play the whales’ own songs back to them, male and female alike, and see if we can get any response.

Experiments conducted by Peter Tyack and Louis Herman in the 1970s and 80s came up with basically the same results. You can get a humpback riled up by playing him or her summer feeding noises during the winter months, because usually in the winter they are just singing, and never eat anything. (Presumably they are mating as well, but no human has ever caught humpbacks in the act. We’ve got plenty of video footage of grays and belugas, though!) When the song itself is played back, the whales don’t seem to care. Sometimes they approach the boat, sometimes they don’t. The statistics are inconclusive, or, as the lingo goes, “not significant.” (Tyack 1983; Mobley et al, 1988)

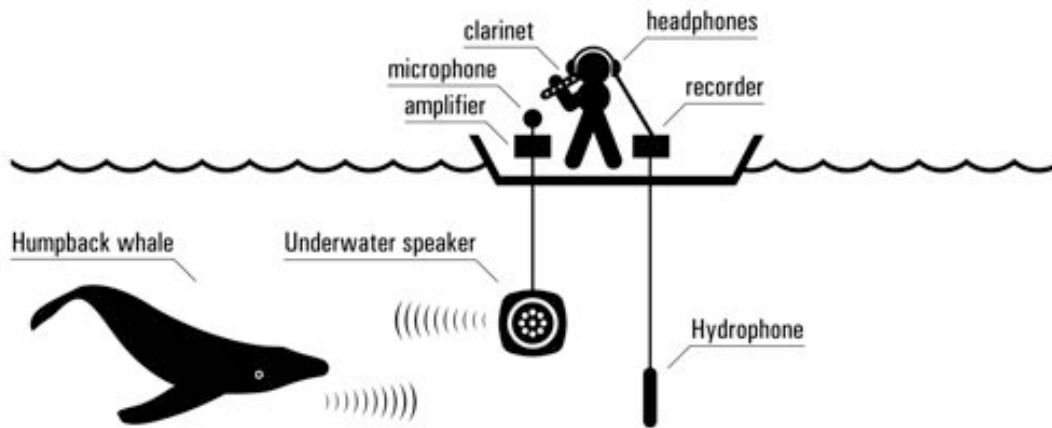
What about other sounds? Control noises, other whales, human music? According to science, the whales don’t seem to care. Unlike dolphins, they just don’t seem all that interested in us.

## **PLAYING ALONG WITH A WHALE**

As a musician, I wanted to hear for myself. Having spent several years playing my clarinet to birds, sometimes getting a response, sometimes not, I was eager to try this interspecies jamming with humpback whales. To my surprise, I got a very different result than they did. So different, that when I played my recording of a humpback whale/clarinet duet to several leading humpback scientists, they did not believe the encounter was real. But I assured them it really happened. What surprised my audiences most, is that nearly everyone considered the sound they heard to be music: a music made between human clarinetist and humpback whale.

In January-February 2007 I spent several weeks off of Maui, Hawaii, trying to musically interact with humpback whales. The making of these duet recordings does not involve getting the clarinet wet. I’m safely onboard a boat and the whale is, ideally, about ten meters underwater, directly under us or within a hundred meters at most. He can be much further and still sound loud

and clear. In fact, singing humpback males usually situate themselves about one kilometer apart from each other. Here's how it's done:



The chain of technology enables the clarinetist to talk to the whale, or, more accurately, use music to cross species lines. Why do I think this is even worth trying? Because music can communicate across cultures in a way language cannot. I've seen and heard this happen. Consider the great Turkish clarinetist Barbaros Erköse. He tours the world as part of Tunisian oud player Anouar Brahem's band. Brahem and the rest of his group speak Arabic, French, and English, but Erköse speaks only Turkish. This is not a problem. They make beautiful music together. It is not Turkish music, it is not Tunisian music, but something unique and in between. (Brahem, 1991)

Can I do the same with a nameless whale? Humpback males usually suspend themselves motionless underwater in a curved posture, singing continuously in a solo trance. I am essentially interrupting a reverie whose purpose we do not know. In the musical moment I do not care about the purpose, but instead wish to understand the result. Can I prove the whale is responding to me in this single best duet, the most exciting several minutes of the many hours I tried to record? Many things can go wrong in such an experiment: the whale might stop singing and move away, a loud motorboat might come near and mess up the sound quality. Scientists might call my duet statistically insignificant, because it represents the one best case scenario rather than the probable result of broadcasting a clarinet underwater next to a singing humpback whale male. But even a single interesting improvised performance is worthy of musical analysis. I want to figure out why I like it, why even the skeptics I have played this to have responded to this sudden music. In my book *Thousand Mile Song* there is no space for this kind of detailed analysis, so I am pleased to be able to present it to you now.

In the following pages I will present and describe this duet in detail, in an attempt to explain what is specifically musical about this encounter. I will first use the phenomenological tools of the listener, that is, describing the sound as it occurs, trying to stick to the experience itself. I will mesh my impressions of the

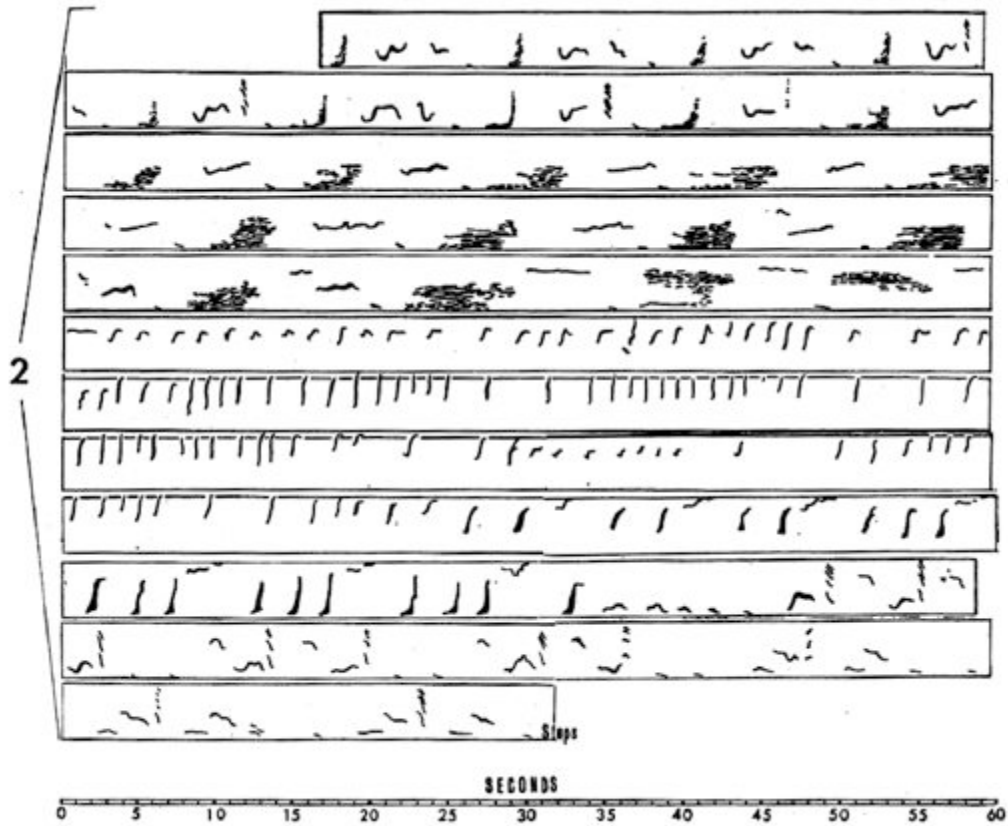
sounds along with the preferred scientific tool of bioacoustics, the sound spectrogram (or sonogram), to see if this visualization method can make musical sense of this sound encounter that crosses between cultures, from one living species to another, in real time, the encounter of the moment.

Sonograms are useful for grasping the structure of unfamiliar sounds because they plot frequency of the sound against time in a direct way across the page. As we listen to sound, it leaves our ears just as soon as it arrives, so it is hard to carefully access then as data. Musical notation is all right as far as it goes, to represent pitches and rhythms according to the conventions of Western music. But all kinds of human music, from African polyrhythms to Indian ragas, are not well served by the five bars and the twelve-note chromatic scale. Much goes on between the lines, and our usual notation has nothing to say about timbre, the specific sound qualities that distinguish one instrument's performance of the same pitch from another.

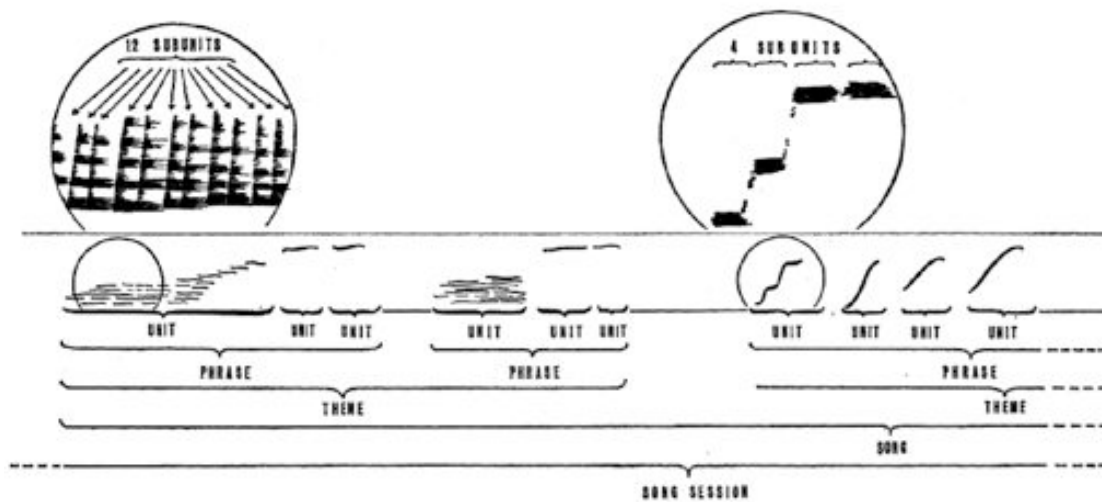
The sonogram helps to reveal what determines timbre by showing the full range of overtones inherent in each sound. A completely horizontal line denotes a steady pitch held out over time—the amount of lines exactly parallel to this line show how many overtones are also produced. A completely vertical line is a rhythmic click, and a wash of black filling the screen would be white noise—in practice, real noise is never completely white, and the sonogram can reveal the subtle differences in noisy sound which musical notation has nothing to say about at all.

When the sound is printed out on a page, patterns and changes over time are instantly revealed and can be considered all at once. When Payne and McVay published the first descriptive paper on humpback whale songs, sonograms were very primitive and they had to trace the patterns they saw and heard onto long scrolls of paper, which McVay and his wife rolled out across their living room floor. Only when the whole thing was visible could they really comprehend the structure, and Hella McVay announced to her husband, “my God, the song repeats,” realizing that they had been listening to whale music all along. (Rothenberg, 2008)

The basic structure of the song is still best articulated in the first paper, by Payne and McVay in 1971. In this hand-traced sonogram traced off the living room floor, you can see the range of sounds the whale makes in a complete song and how it all fits together over the period of eleven minutes:



Payne and McVay identified a hierarchical level of organization at work in this song that has been accepted by most scientists who have studied the song over the last four decades:



In 2007 a PhD thesis was finished at Cornell University by Renata de Souza-Lima, challenging the large scale notion of the “song” as a valid entity in comprehending humpback whale vocalizations. (Souza-Lima, 2007) She believes that the beginnings and endings of whole songs identified by Payne and McVay, a length of performance lasting from eight to twenty minutes, is much more an arbitrary indication of when the whales happens to start and stop, rather than any objective level of analysis. Long bird performances like that of nightingales and mockingbirds are usually called “song bouts” rather than long songs, this enables scientists to focus more closely on shorter, more comprehensible levels of organization. Souza-Lima accepts the Payne and McVay analysis up to the point of phrase and theme. Beyond the theme, however, she doesn’t see any biological relevance to calling the whole thing a “song.” (Souza-Lima, Cholewiak, and Cerchio, 2007)

It’s certainly *easier* to concentrate on shorter units, especially unit and phrase. In the analysis of the clarinet/whale duet below, I will be mostly speaking of interaction between the species at the level of unit and phrase, as that is easier to identify and to track, even when dealing with human improvised music.

It may also be that the whole sense of a longer “song” with beginning and end is something Payne and McVay heard colored by their background, especially Payne’s, in Western classical music. He’s an accomplished cellist, and in his popular lectures he would often play his cello along with whale phrases to illustrate the beauty and range of the animal’s sound. If a scientist familiar with, say, North Indian music was trying to make sense of the humpback whale song, he might instead hear a structure more akin to the raga and tala: a series of melodic and rhythmic rules that could be combined in almost endlessly different ways, from either a few minutes to a whole night in length, and still be considered the same piece.

Our musical background colors what we hear, but our scientific background in the interpretation of diagrams colors what we see. No whale song scientist I spoke with really seemed to be a connoisseur of the song, who could hear a phrase and immediately know which theme the phrase come from, and tell whether it was a new innovation in the song or something that had been in circulation for years. They all had to print it out in sonograms before they had anything to say about it. And even then we are mostly at a loss for words when having to describe what is musically happening in: Are these shrieks, wails, bleeps, blatts, howls, cries, or screams? Human language has never been very good at expressing music.

To scientists the sonograms represent an objective solution to this quandary, where fleeting sound has been turned into something visually exact. However, the story is not so simple. Historian Peter Galison has done research into the process by which the visualization of scientific data colors what is able to be proven. (Galison, 2002) He talks mostly about the paintings of visual spectra produced by chemical flames: unlike the full range spectrum we see from the sun through a prism or diffraction grating, when chemicals burn there are vertical lines in their spectra, which enable us to identify which elements are in the fire. Galison points out that it is not always easy to see the peculiarities in the spectra. The chemist must learn to see, a process that the historian sees as a question of aesthetic judgment and criticism, closer to the education required of an art critic

than that of a scientific observer who trusts only exact numbers and calculations. Visualization of scientific data thus has a cultural history, something that calls the absolute rigor of science into question. They don't want to hear about this!

With sound spectrograms, the issue is even more present. The bioacoustician adjusts the scale and parameter of the horizontal and vertical scales of the sonogram in order to best reveal the patterns and timbre in the unfamiliar sound. We want to see order, so we adjust the scale and appearance of the diagram so such order appears. This is an aesthetic axiom in itself.

In the whale/clarinet duet sonograms you are about to look at, I have adjusted the appearance so that the two parts are clearly visible. Here is a summary of the whole mood: The whale sounds have a huge range, from 100Hz (G2) (in the form of clear *broomphs* (not a technical term), visible as round, sine-like tones with few overtones. But then the whale may suddenly jump to high, wavering whistles that resemble the timbre of the clarinet, with a series of parallel overtones. The pitch of the whale's high whistles, though, is rarely steady, but warbles about twice a second around between 300-600Hz (E4-D5), in the third octave of the clarinet. Then occasionally there will be an extremely high note, around 4800Hz, coming almost immediately after the *broomph*, from the same whale. How can he jump so high so fast? I'm afraid we really have little idea how the humpback whale makes these sounds at all.

The clarinet sounds are often high, held-out notes, more constant in pitch and thus closer to straight horizontal lines on the sonogram printout. There are usually at least a few parallel lines of overtones, more than usual for the instrument because the clarinet is being broadcast underwater, and the properties of underwater sound propagation seems to add overtones to the timbre, making the clarinet more bell-like, closer to a soprano saxophone (which, because of its conical bore, produces more overtones). Yet after some minutes, my clarinet starts to produce higher, shriekier, and more uneven, warbling notes, not exactly like the whale but somehow more compatible with the whale.

And what does the whale do? Does his sound become more clarinet-like during the encounter? I am not really sure, but some of our high squeaks are quite hard to tell apart. And the clearest sign of communication comes when I stop, and he begins with a direct sense of response, in some cases continuing the very same note I just finished, and in other cases trying to join in, and overlap me with a complementary sound.

To truly assess the musicality of this encounter, and decide for yourself whether this interspecies duet is music or not, you should first of all listen to it. An mp3 of this four minute excerpt is posted here:

<http://www.thousandmilesong.com> [should be up in a few months] Listen for yourself, and perhaps we can set up our own Martinellian survey: Is this duet music: yes or no?

## THE WHOLE SONOGRAM

This recording was made on Feb. 7, 2007, off a boat owned and operated by a woman we shall call Captain Clara, because she does not want to reveal her real name, since the aiding and abetting of musicians who try to harass whales by playing amplified underwater clarinets to them is against US Law according to

the Marine Mammal Protection Act of 1972. She doesn't want to lose her license. A Leblanc Noblet clarinet was played into an AudioTechnica AT822 microphone, which was routed through a Sony TCD-7 DAT recorder as a preamp into a Roland battery-powered Canister amplifier, modified to drive an EsunPride JH001 underwater speaker, which blared the clarinet sounds into the ocean, where they are able to travel five times faster and farther than in air.

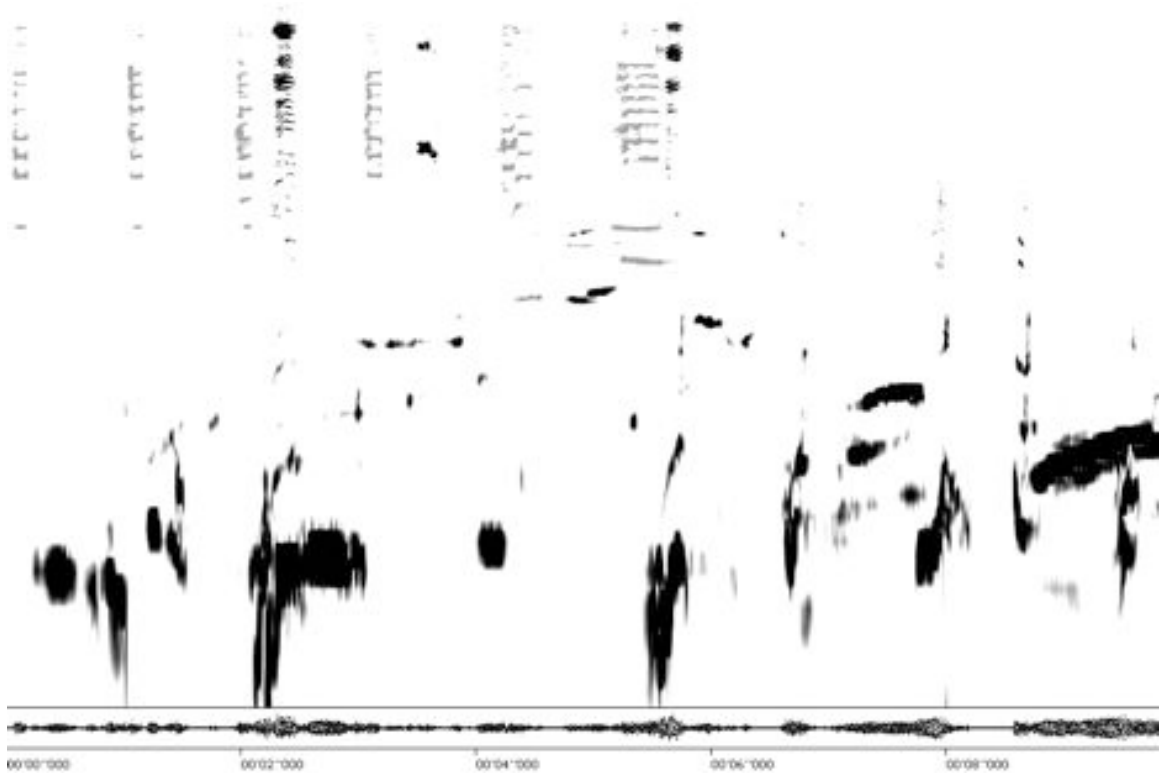
Two Cetacean Research SQ26-08 hydrophones picked up the sound of the clarinet, along with one especially nearby whale and one more distant whale (probably about a thousand meters away). The hydrophones were dropped on each side of the boat, and because they are only four meters apart this does not produce a true stereo underwater recording, but an artificial kind of slap echo. These hydrophones were routed into a Sony MZ-M10 Hi-MD Minidisc Recorder, which records uncompressed PCM audio at 44.1 KHz per second. The resulting recording was loaded into Ableton Live software on a Macintosh PowerBook G4, and run through Bias SoundSoap Pro noise reduction software and some compression to make the interaction between clarinet and whale easier to hear. Sonograms were printed out using Amadeus, a shareware program available from [www.hairersoft.com](http://www.hairersoft.com). Algorithm and visual parameters were adjusted to make both the clarinet and whale parts of the duet appear distinct on the screen.

One could argue that I have edited and massaged the sound to make it more interesting to listen to, but what I have most specifically *not* done is to edit out sections of the duet to make it seem more engaging. What I *have* done is selected the most interesting four minute section of our interaction, and from all the interactions I tried for over several weeks of going out on the water to play with whales. The section depicted below occurred about two minutes after I began to play along with the whale, and after these four and a half minutes the duet continues for another eight minutes, with a similar level of interaction. Then another boat came near to us, there was too much underwater noise, and the whale stopped singing shortly after.

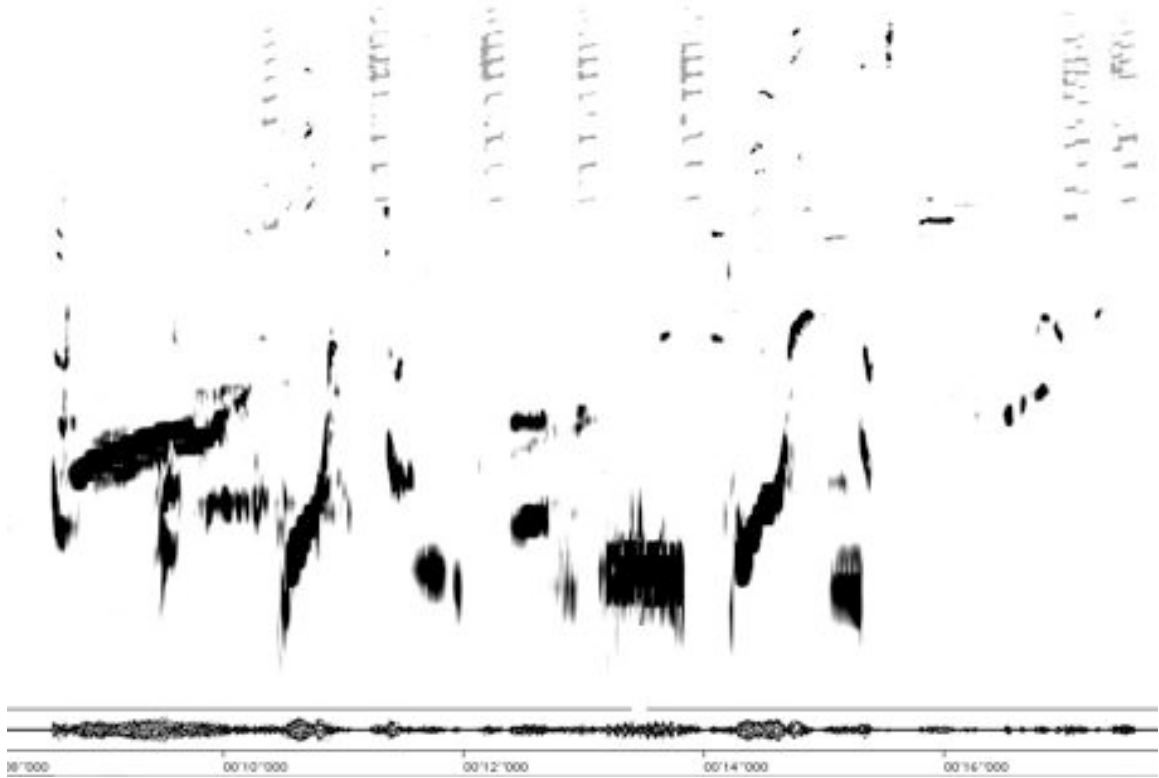
Scientists who conduct many playback experiments sometimes say that the first encounter of the animal with the playback can be the most interesting, because there is an initial excitement and interest that may fade once the animal realizes that the strange sound is not really of value to him. They tend to discount, then, these original results and sign of response. For a musician, however, if interesting music comes out of it, even if you hear it once and never again, it still could be a valuable encounter. We take what we can get.

Complete sonograms of complex animal vocalizations rarely appear in scientific papers. For one, they take too much space, and the field of bioacoustics generally prefers a single statistical table to pages of descriptive commentary. But music cannot be easily summarized that way. I'm hoping that presenting the most interesting portion of the duet will at least give some suggesting evidence that humans and humpback whales are able to musically communicate. If it happens once, then we can conclusively say it is possible! So here it is. Listen, look, and only then read what I have to say about the course of the duet. The clarinet notes have been highlighted in gray, the whale sounds are in black. The frequencies that appear for the clarinet are extremely high harmonics or overtones, rather than the fundamental pitches, which are easier to get by listening to the recording. In contrast, the whale tones come across as simple harmonic fundamentals. What senses of order and randomness can we hear and

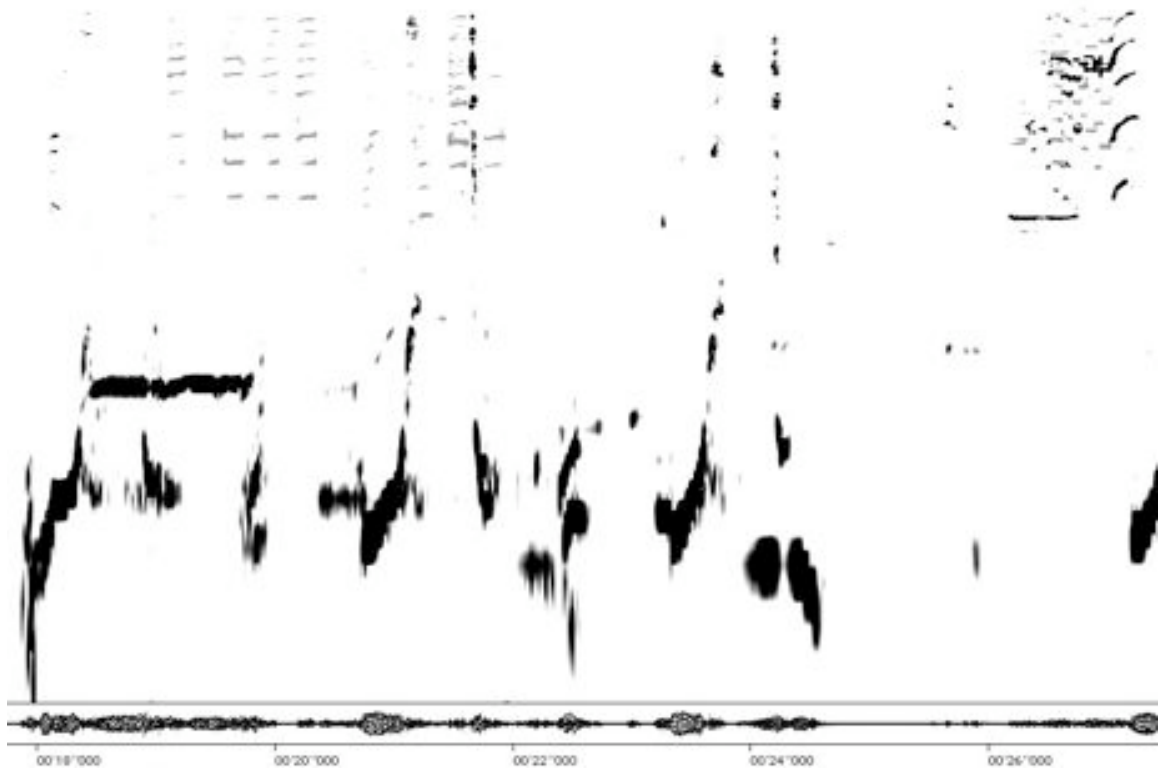
see? Each frame presents about ten seconds of clarinet/humpback whale interaction. The whale tones generally appear lower on the sonogram, although sometimes the whale makes an astonishing sudden leap up into the high frequencies, revealing a full seven octave range.



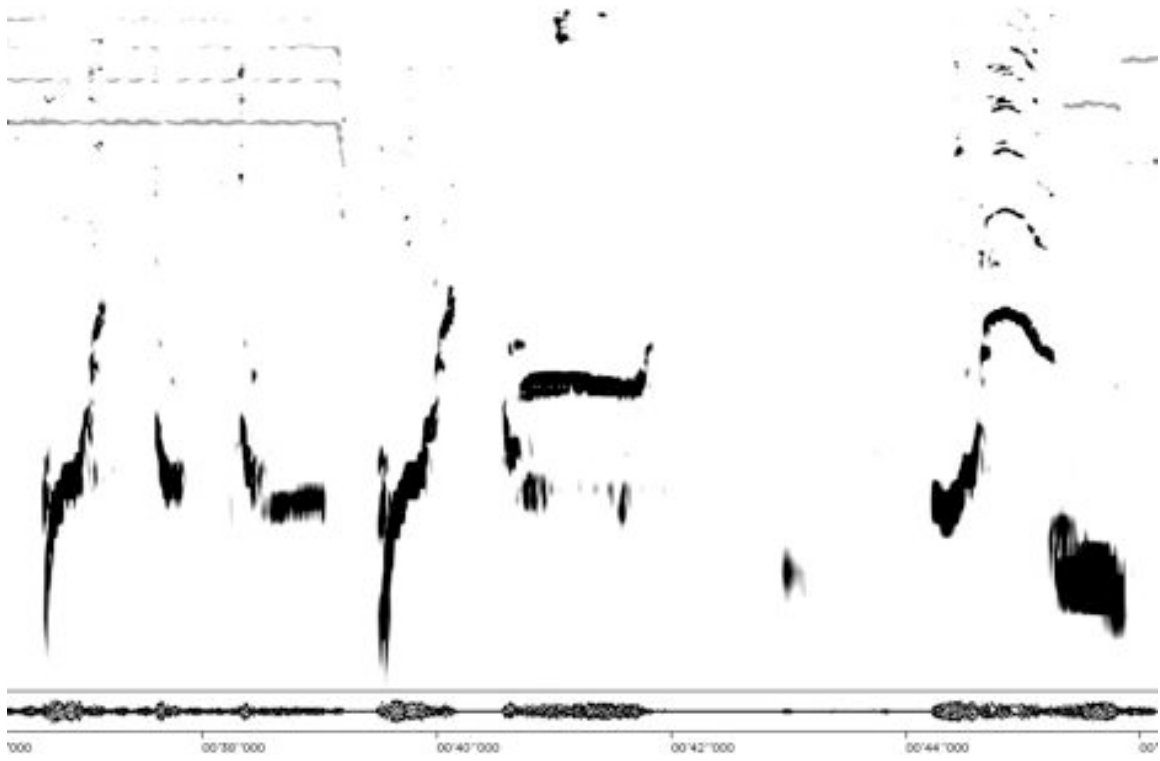
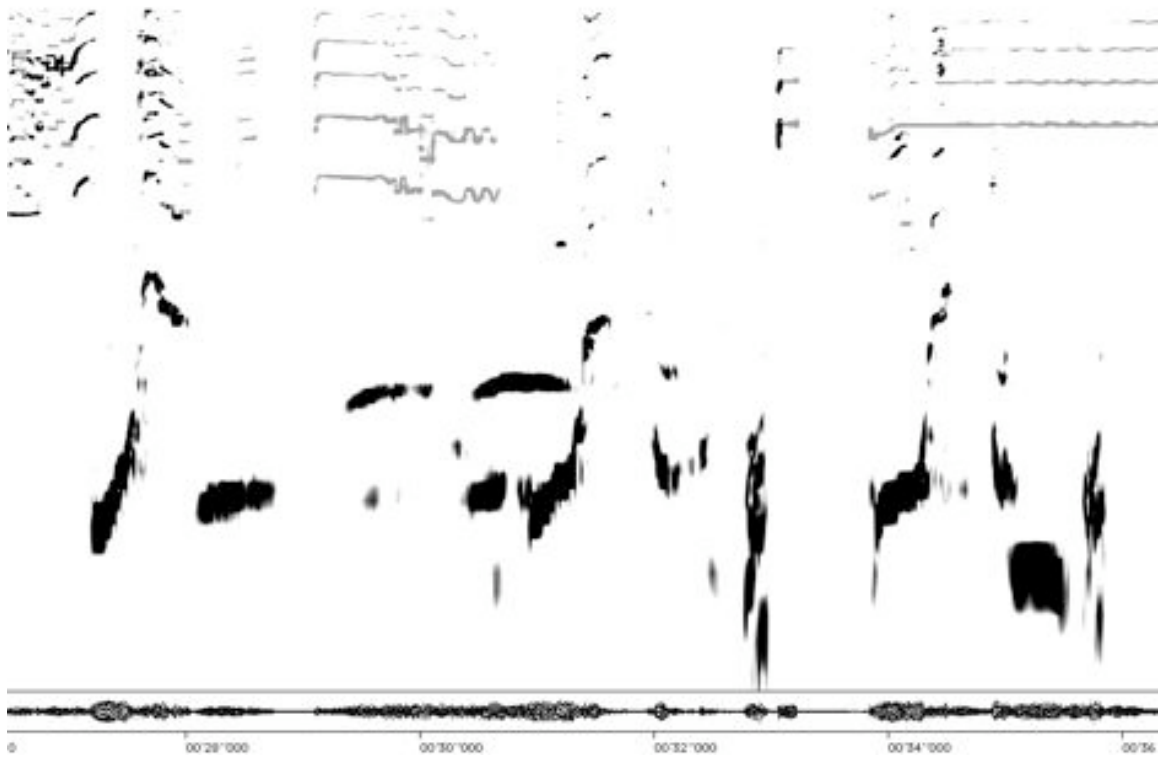
Right at the outset we hear a form of tone and rhythm matching, where the whale seems to match the middle C, 260Hz (C4) he hears on the clarinet twice (2.1" and 5.5"). Then his successive descending whoops echo the roughly one-second beats suggested by the clarinet. If we compare the pacing of this response with the usual speed of this particular theme, it is faster than usual, suggesting that the clarinet's presence is having an effect on the whale's overall tempo.



Now the clarinet moves up to a 370Hz (Gb4) for its repeating beats. Note that at 10" and 14" the whale inserts a *whoop* followed by rhythmic descending notes. My approach in the duet is to play tentative, testing notes, leaving space to listen for what the whale does. A skeptical listener could say this makes any interaction sound like a duet, but let's see what happens.

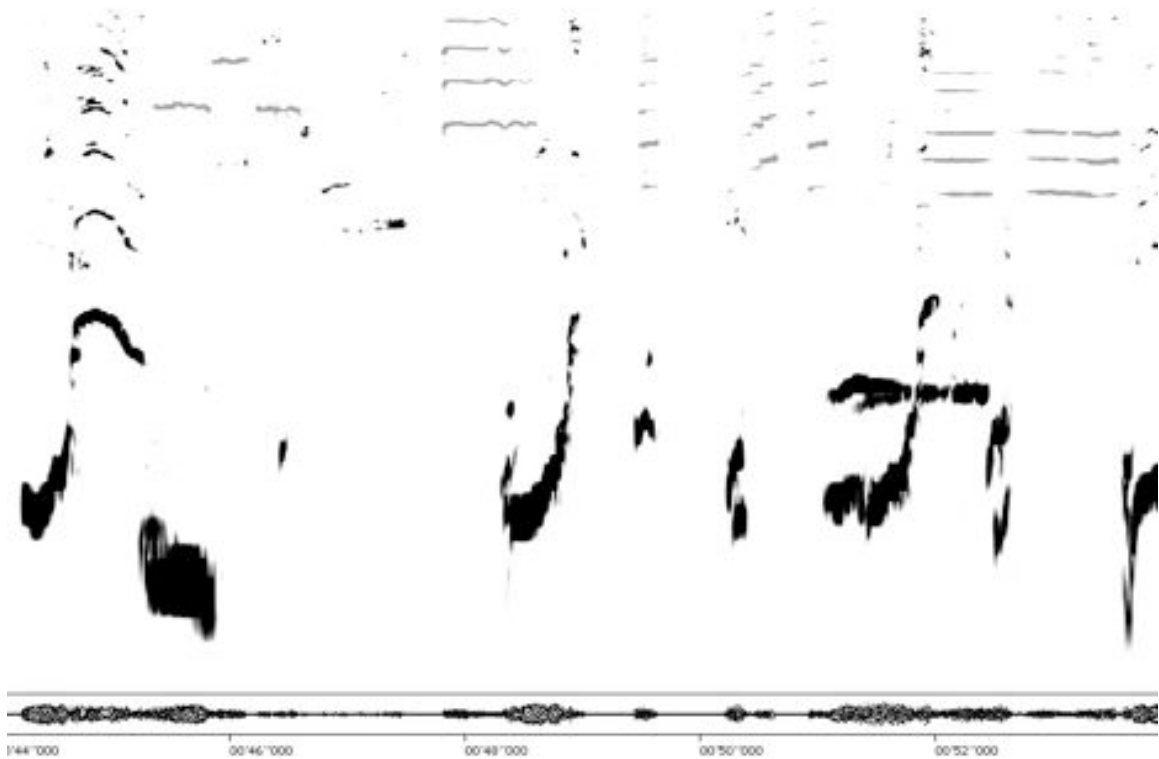


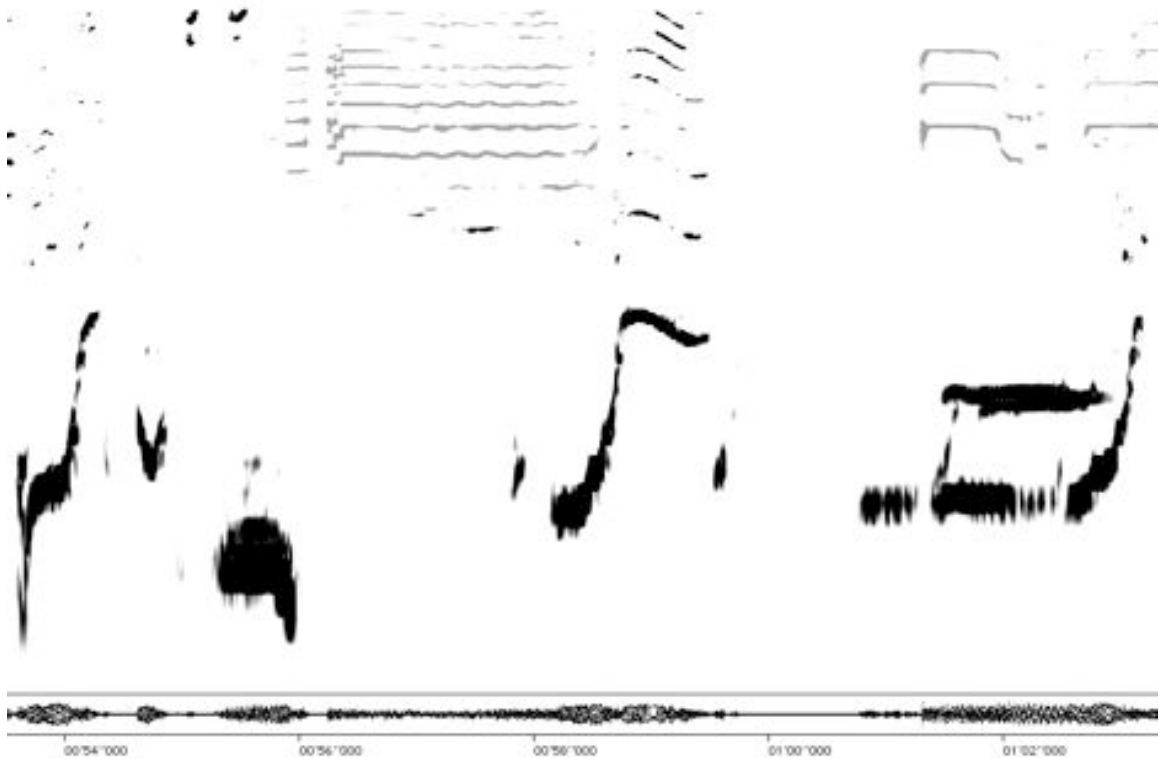
At 21" and 23" the whale adds a descending *gulp* after his *whoop*, and then after I play a glissando up to 831Hz (Ab5) at 26" the whale *clearly* responds with a high cry immediately afterwards at 26.5", the closest acknowledgment from the whale thus far.



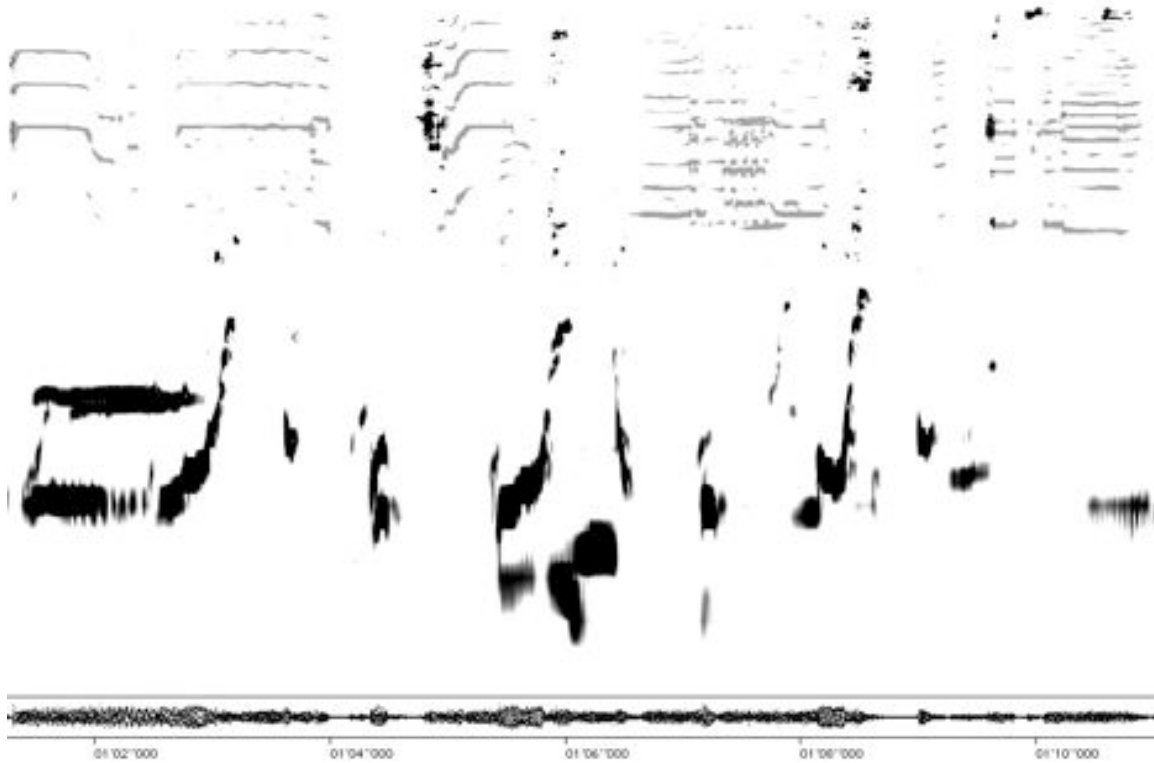
At 41" the whale sings an insanely high squeak around 4700Hz (D8), and then at 45.5" I try to imitate it by playing my teeth on the reed. Fellow humans on the boat did not enjoy this sound, and most of them were not listening to the underwater whales through the headphones, so they weren't hearing the whole thing.

As the encounter progresses, I found myself playing fewer phrases that I enjoyed and more that seemed to engage the leaps and plunges of the whales' aesthetic world. Listening to both species, it's unclear just who such music would be for, if neither people nor whales really want it. I guess each of our kinds can expand our awareness through such an alien musical process.

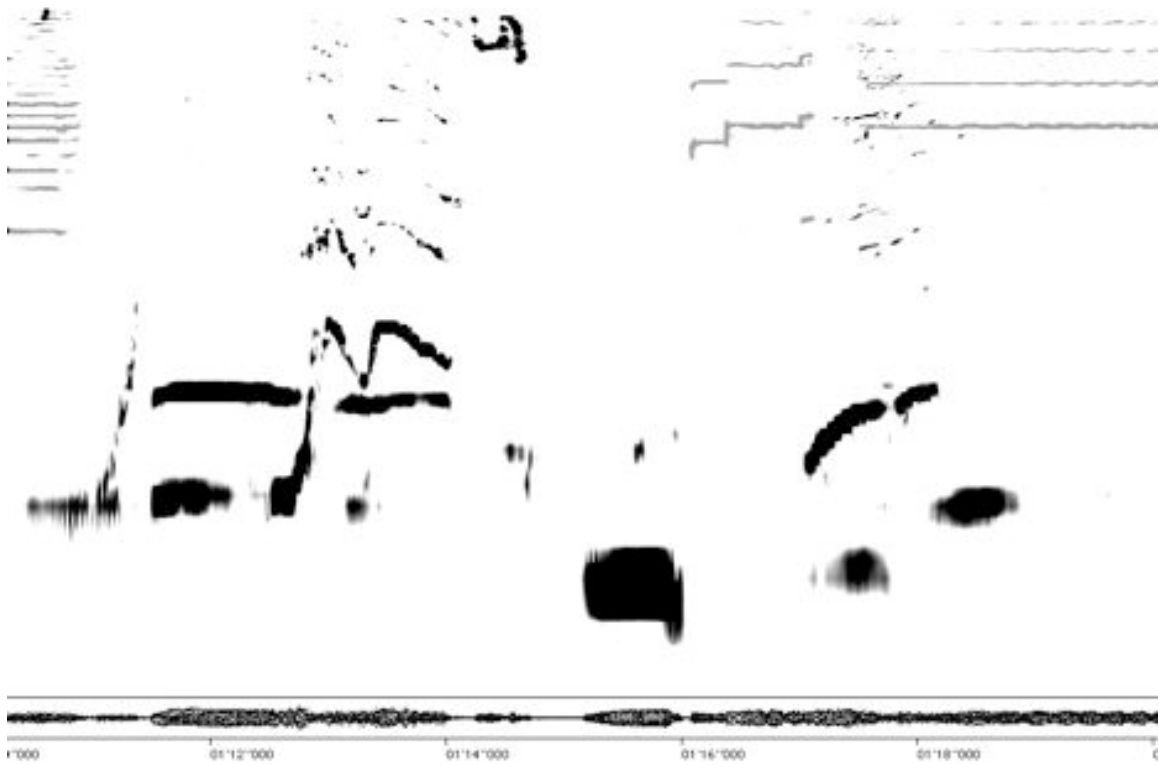




At 55" the whale makes two superhigh squeaks again, and then after my short bluesey phrase he seems to match with the *booweah* sound, and then we are all together, me and the two whales, playing almost a single chord at 1'02".



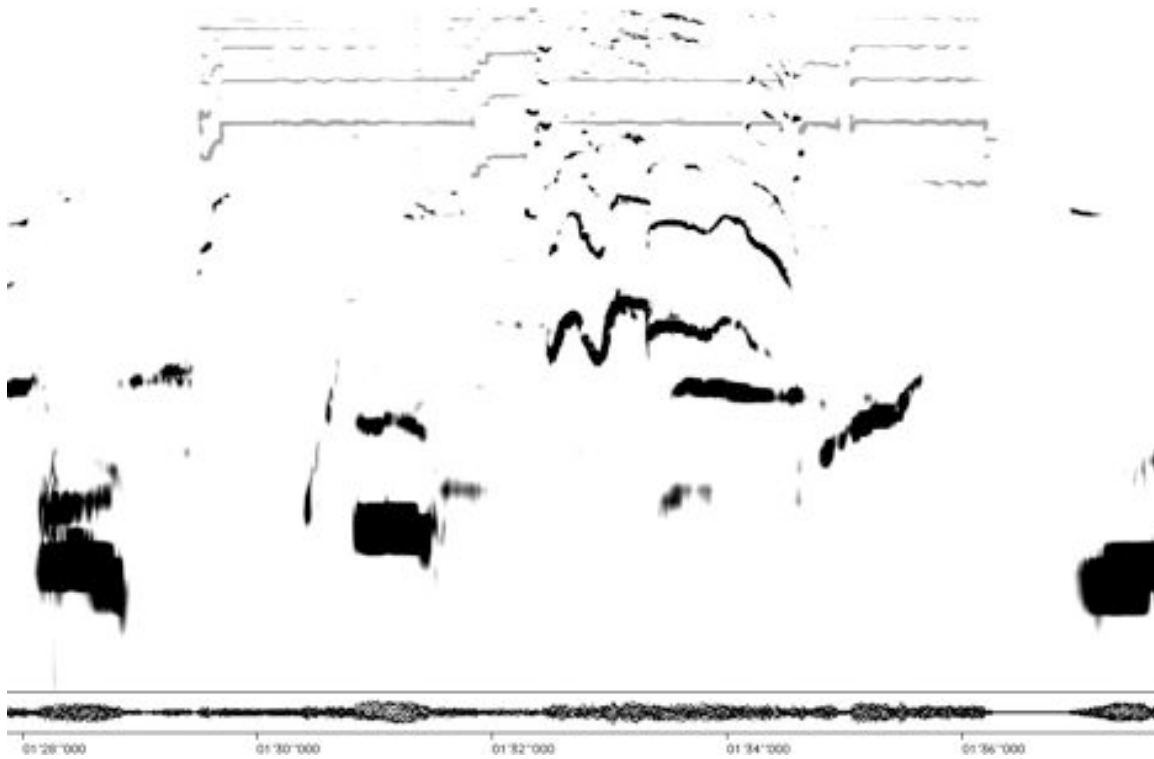
In this passage one clearly sees and hears the tendency of the whale to respond with a full spectrum whoop up to the stratosphere as soon as the clarinet stops playing. From 1'12" to 1'14.5" is the grand phrase from whoop to squeak, then with a deep grunt (almost like the boom of a giant bullfrog) showing in a few seconds the full range of humpback music. At 1'15" the clarinet moves from 1175Hz (D6) to 784Hz (G5). [only higher overtones appear on the sonogram, so the notes look similar, the movement from three to four parallel lines is the key], and at 1'18" the whale appears to gliss up to join my steady G5 with an upsliding moan that anticipates my pitch.



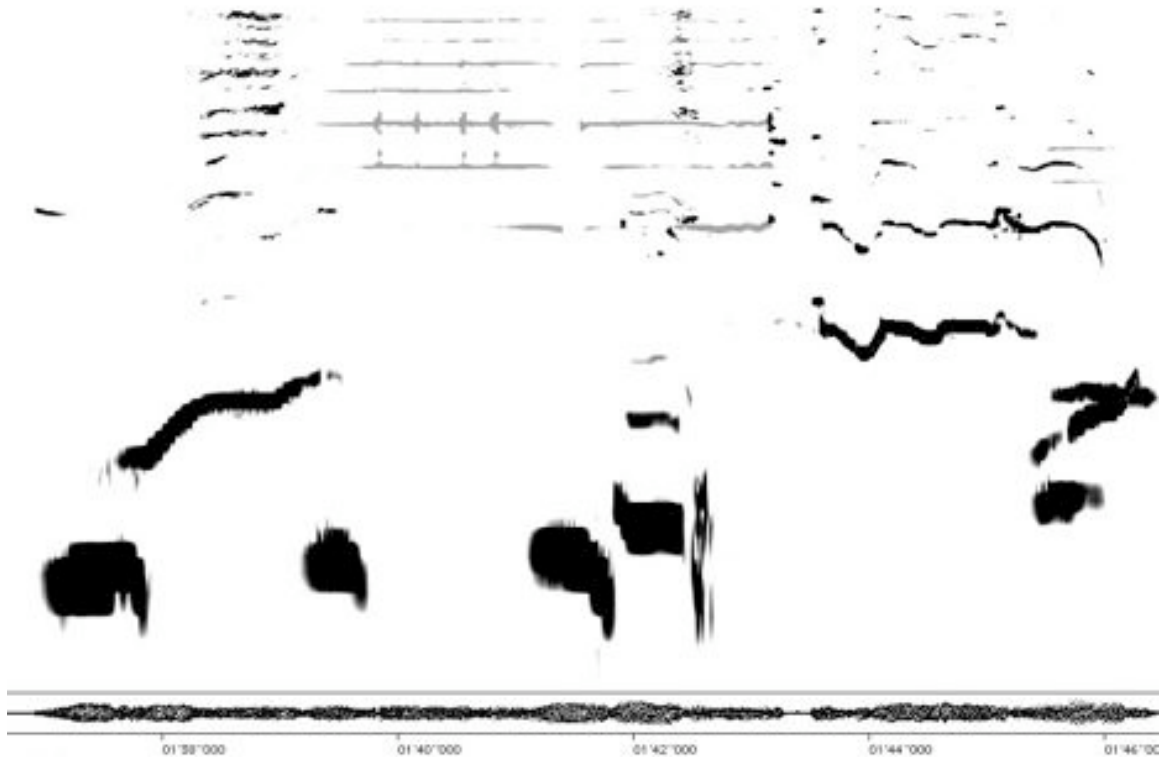
In response to two instances of a held-out G5 on the clarinet, the whale offers two responses, first, the great warbling whistle at 1'22.5", and then the upsliding pitch-matching moan at 1'27".



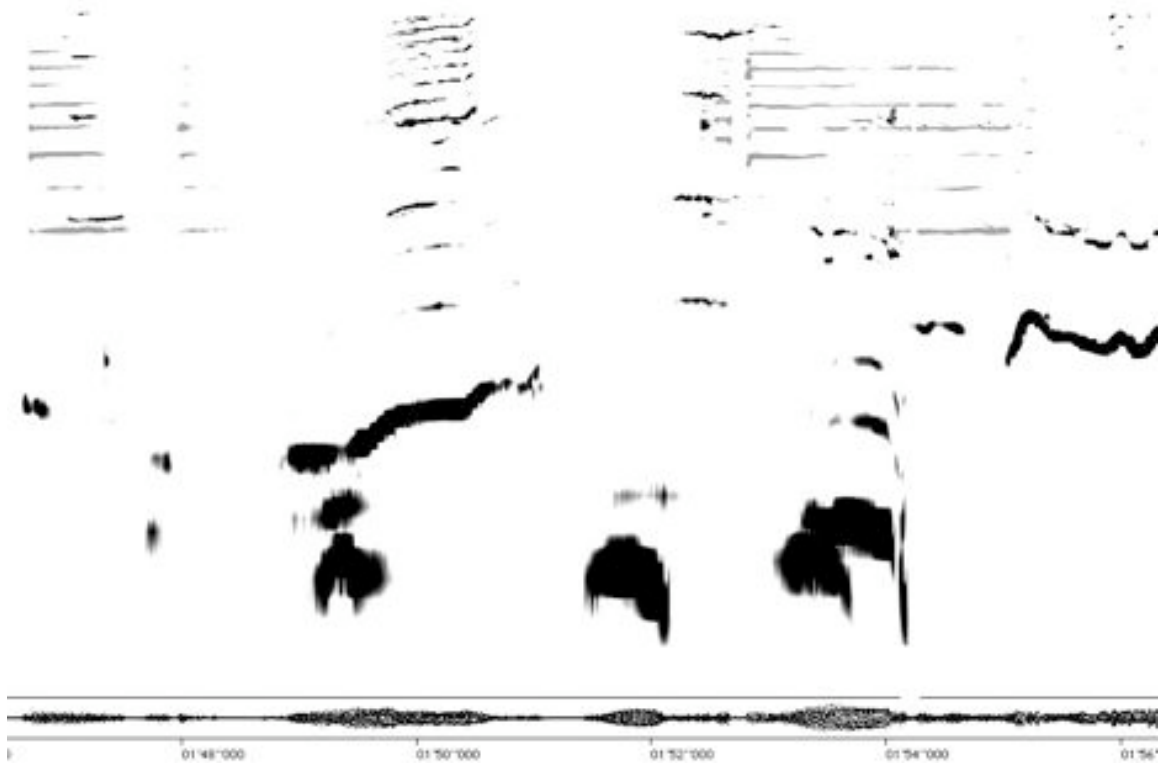
At 1'32" we hear the whale attempting to match the changed pitch of the clarinet held note from G5 to 932Hz (Bb5), a frequency of warble we have not previously heard , a third or so higher, 698Hz (F5) than a similar warble at 1'12" , 587 Hz (D5).



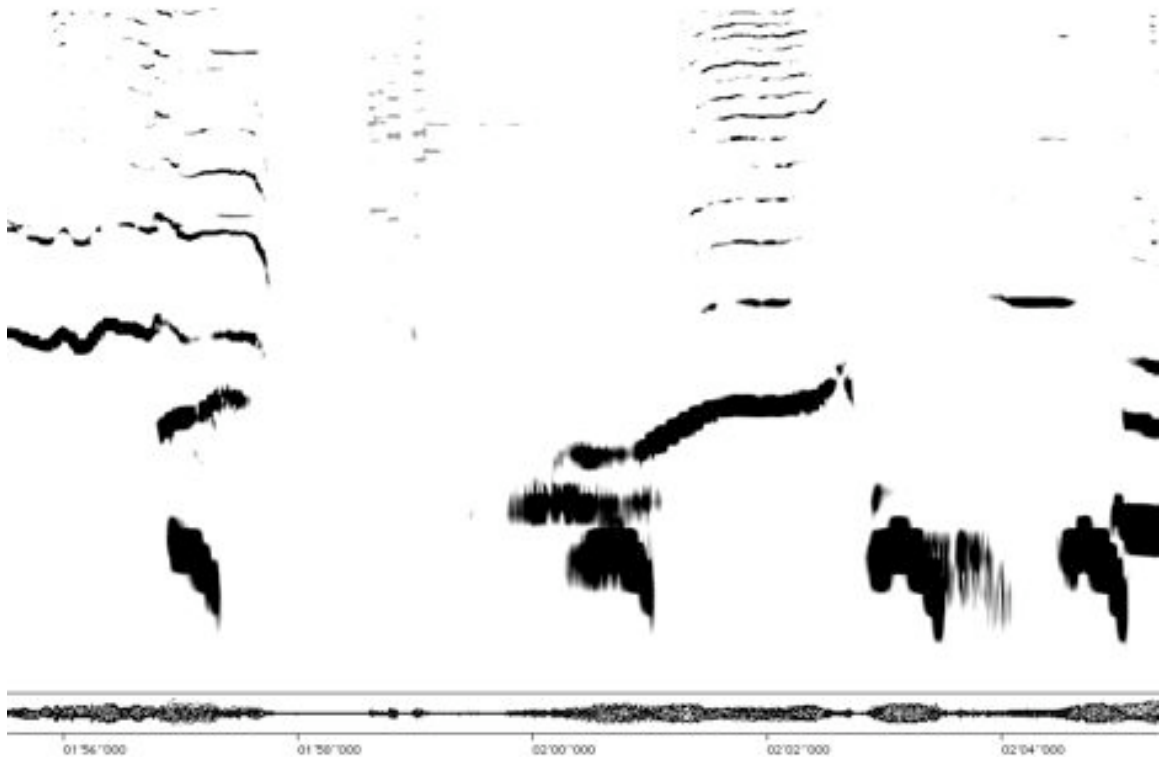
At 1'43.5" the whale remarkably matches the earlier pitch, D5, with a warbling that gradually approaches the steady note:



At 1'55" a different contoured whale whistle attempts to match the clarinet pitch. Or is this all wishful thinking of an interspecies dreamer?



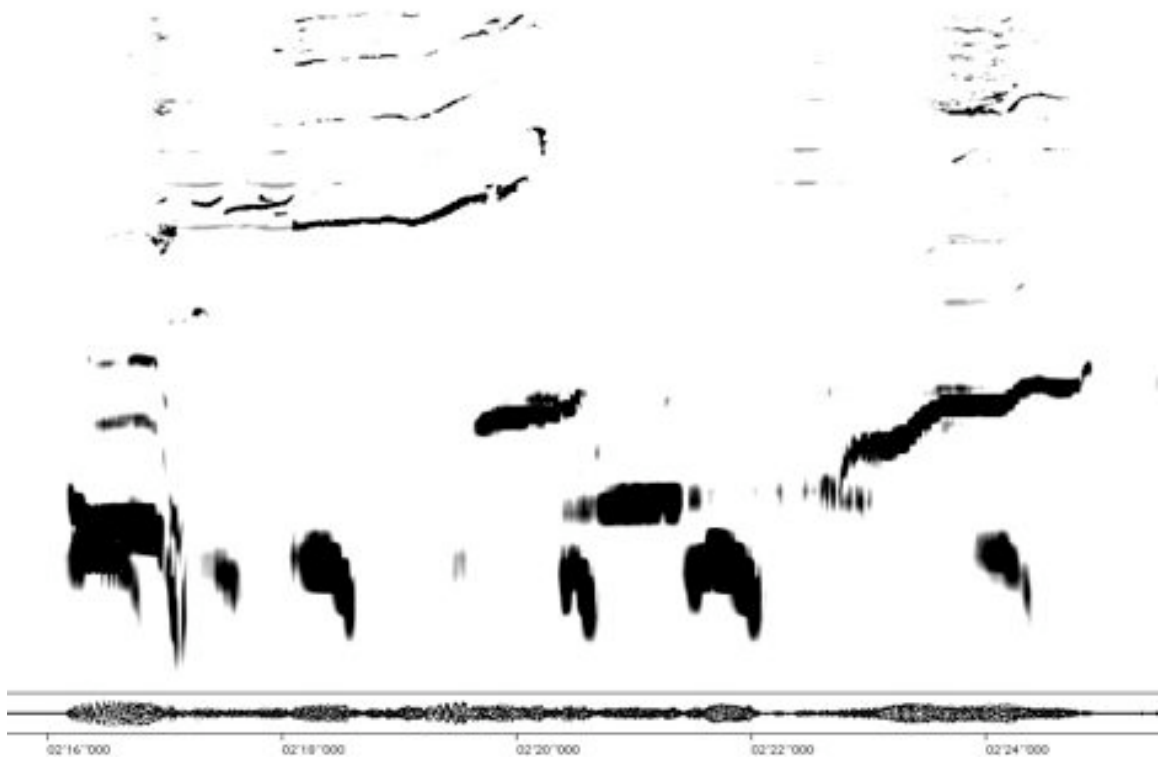
Even the long upsweep from 2'00" to 2'02" seems to strive for that clarinet pitch.



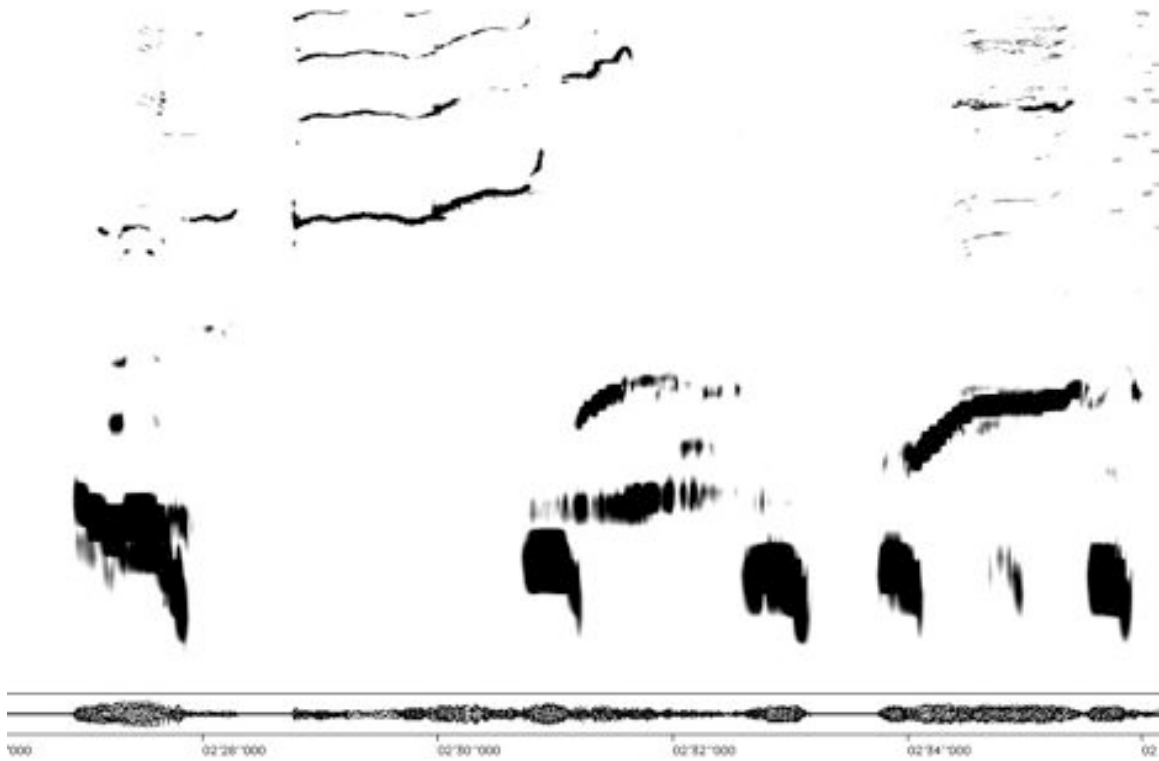
From 2'07" to 2'08" we hear the grand culminating seagull scream.



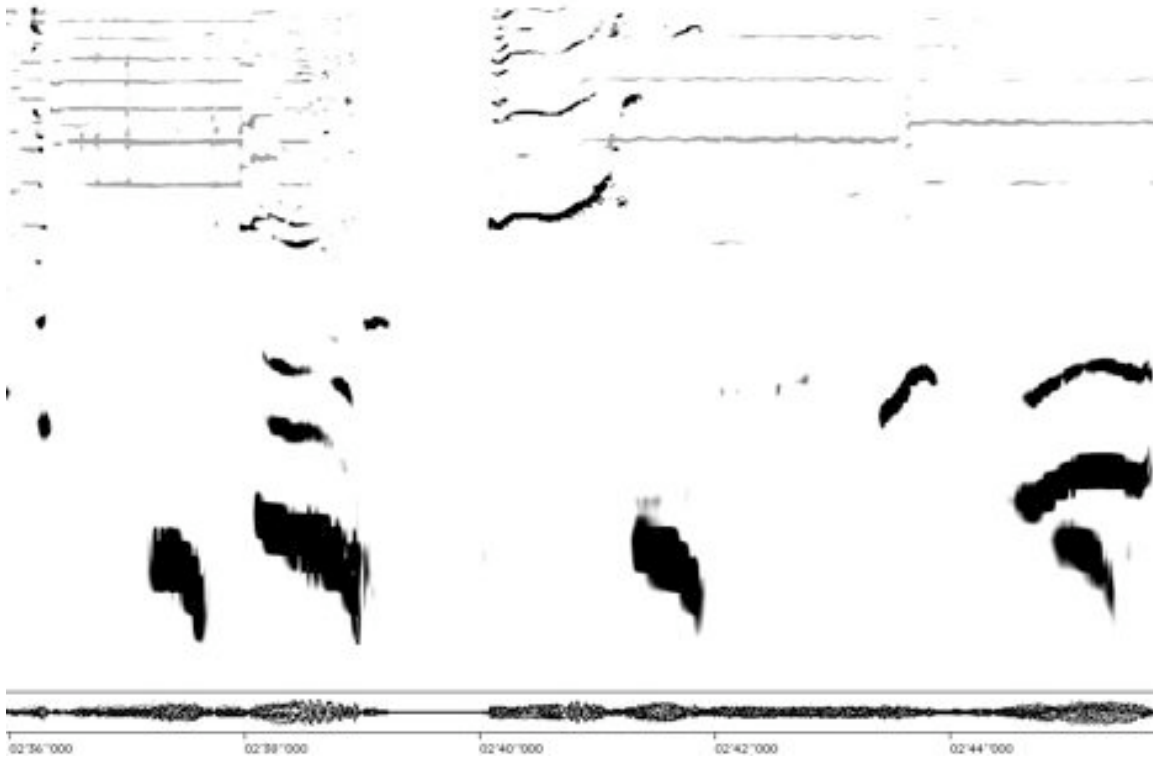
And at 2'19" it appears again.



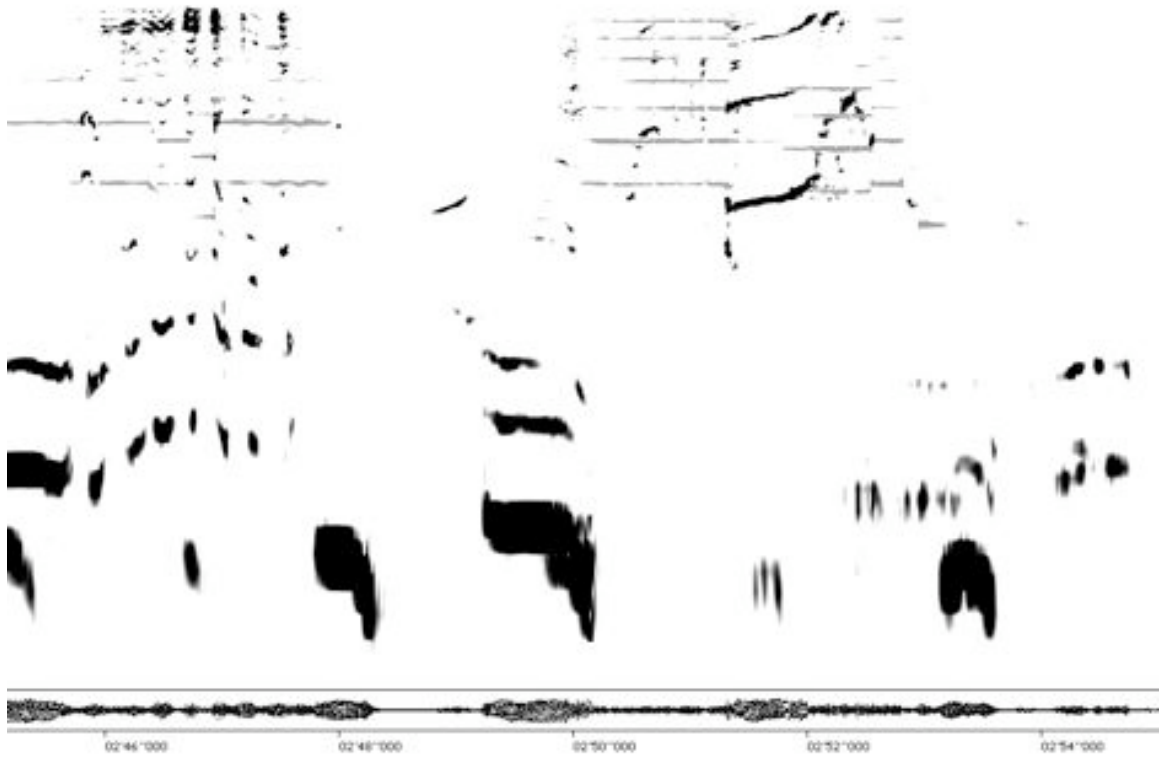
And again with greater flourish at 2'30''



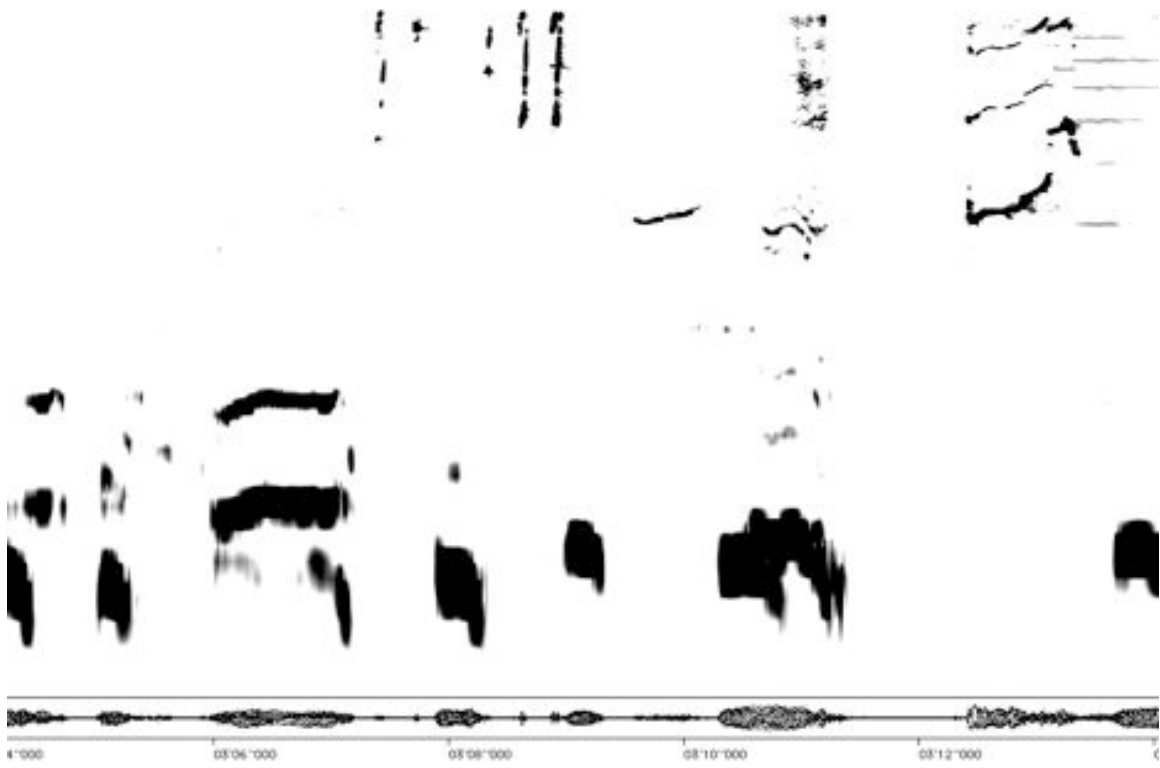
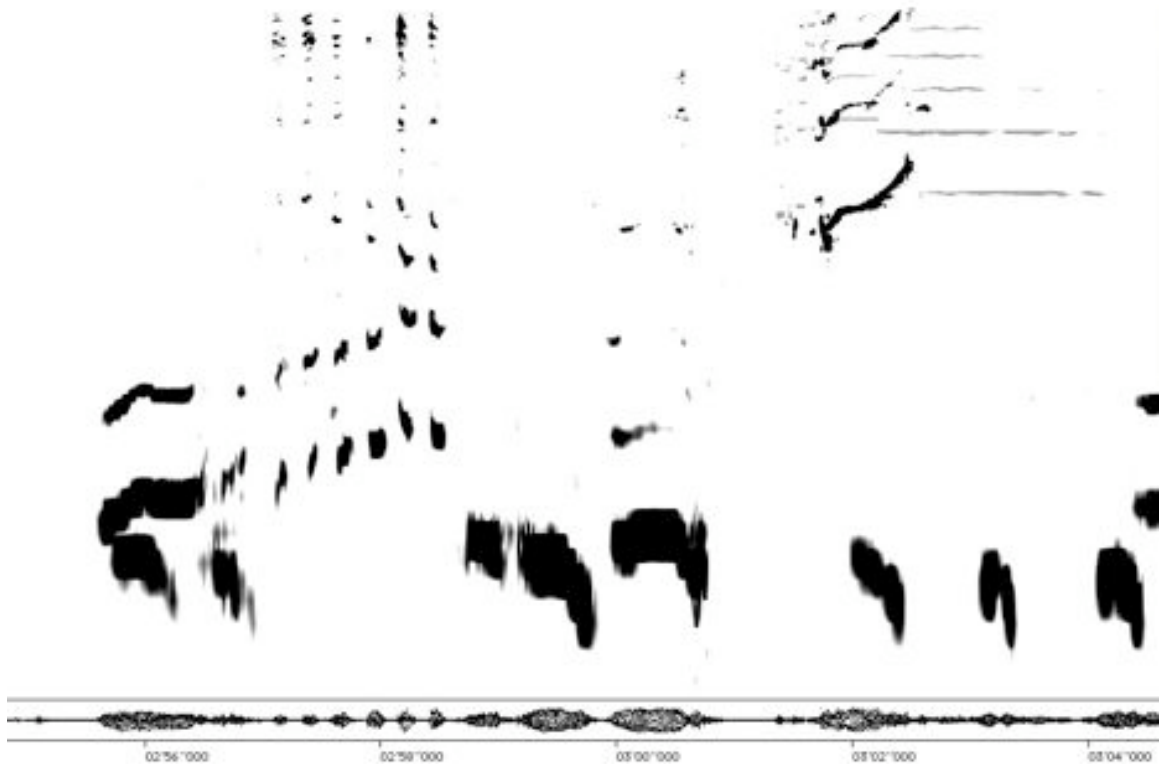
At 2'38" he responds with a downgrunt and then I seem to match his upsweep at 2'41".



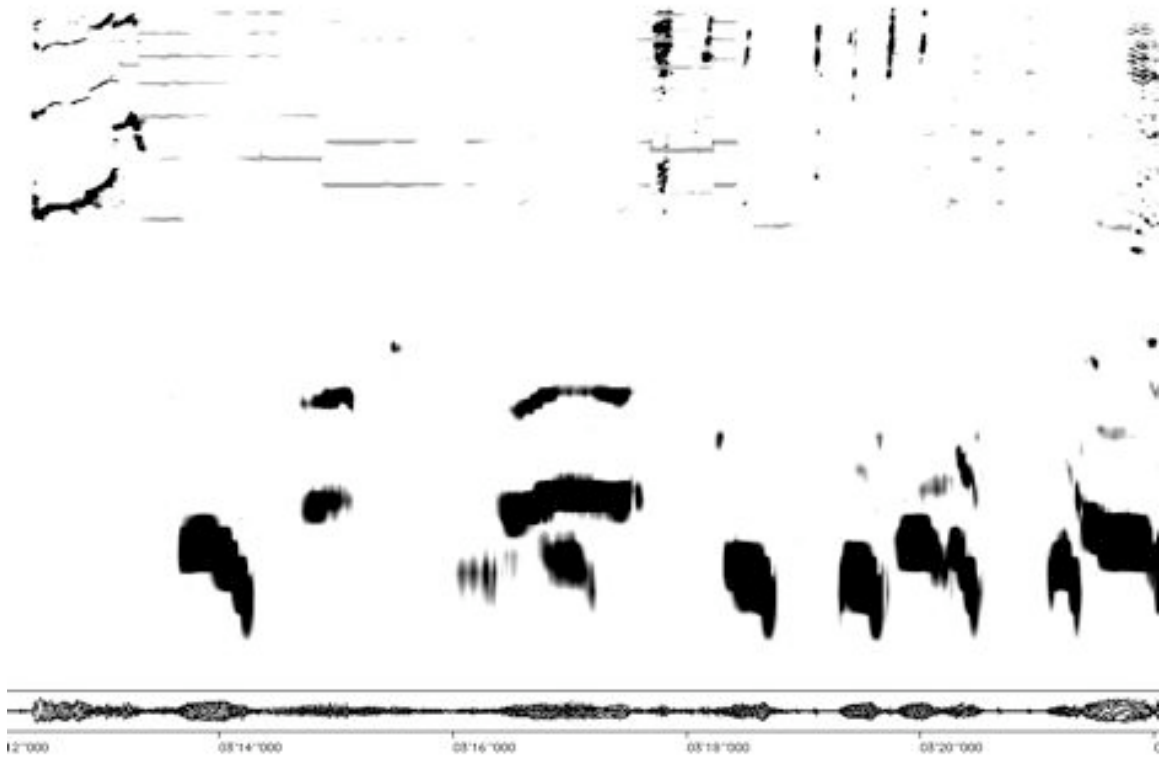
At 2'46" comes the newly heard chopping sound, clarinet high on top of it, then more steady notes broken by a whale upsweep, as the rhythmic presence of the low grunts increases.



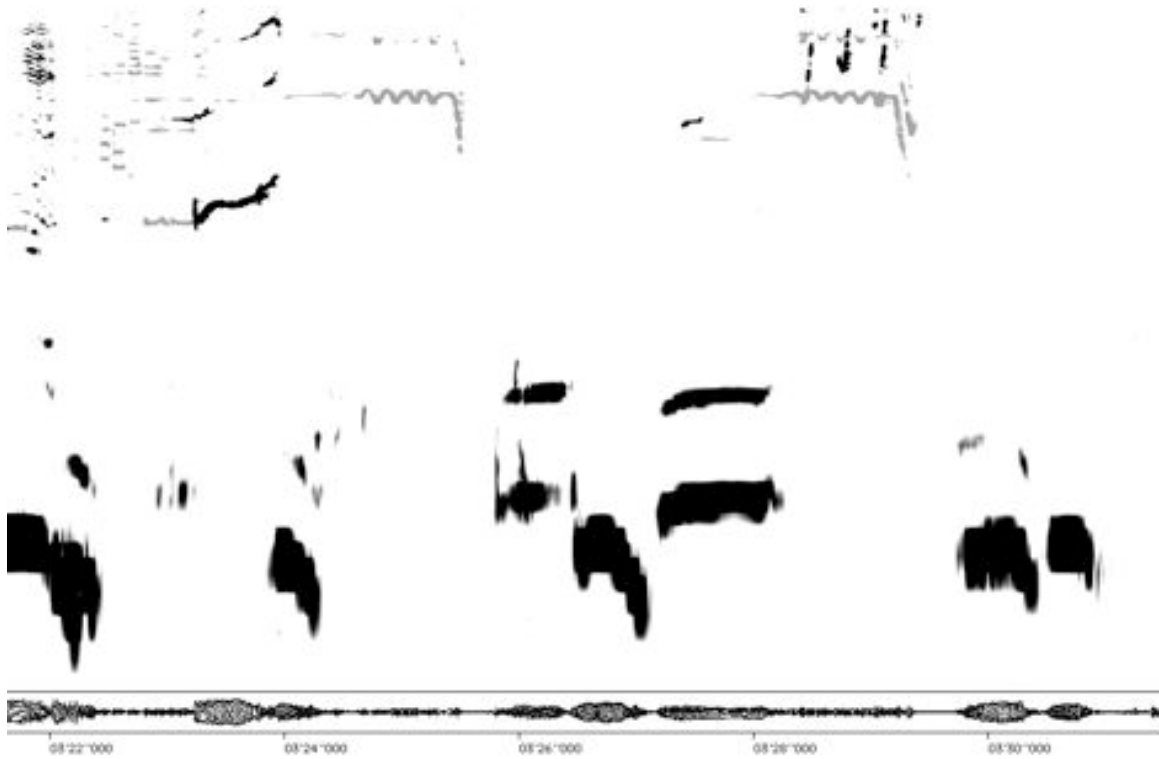
The choppiness comes again at 2'57", before a blustering clarinet gliss at 3'01" brings another upsweep of whale into a high held out note. This is becoming a familiar pattern.



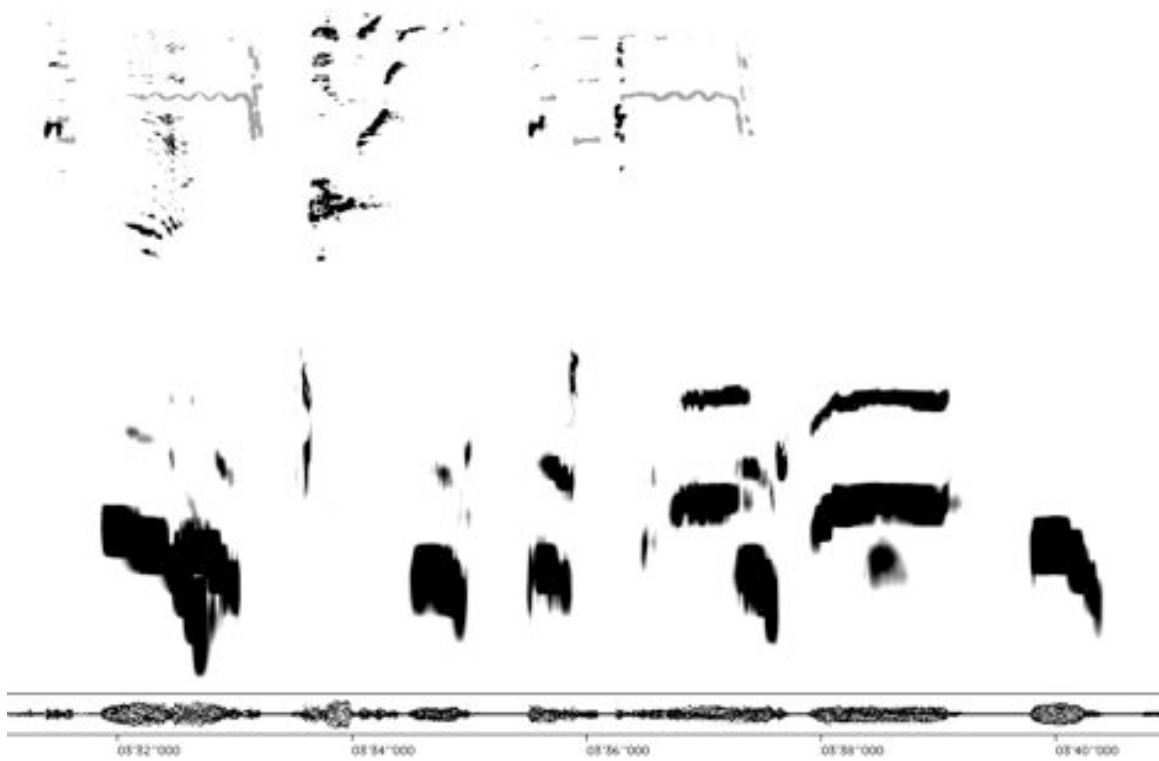
A new kind of very high whale sound appears, like rapid bow strokes on the bridge of a violin. This builds the mood for the moment when the situation really draws me in to create a sound quite unlike any I had ever played before.



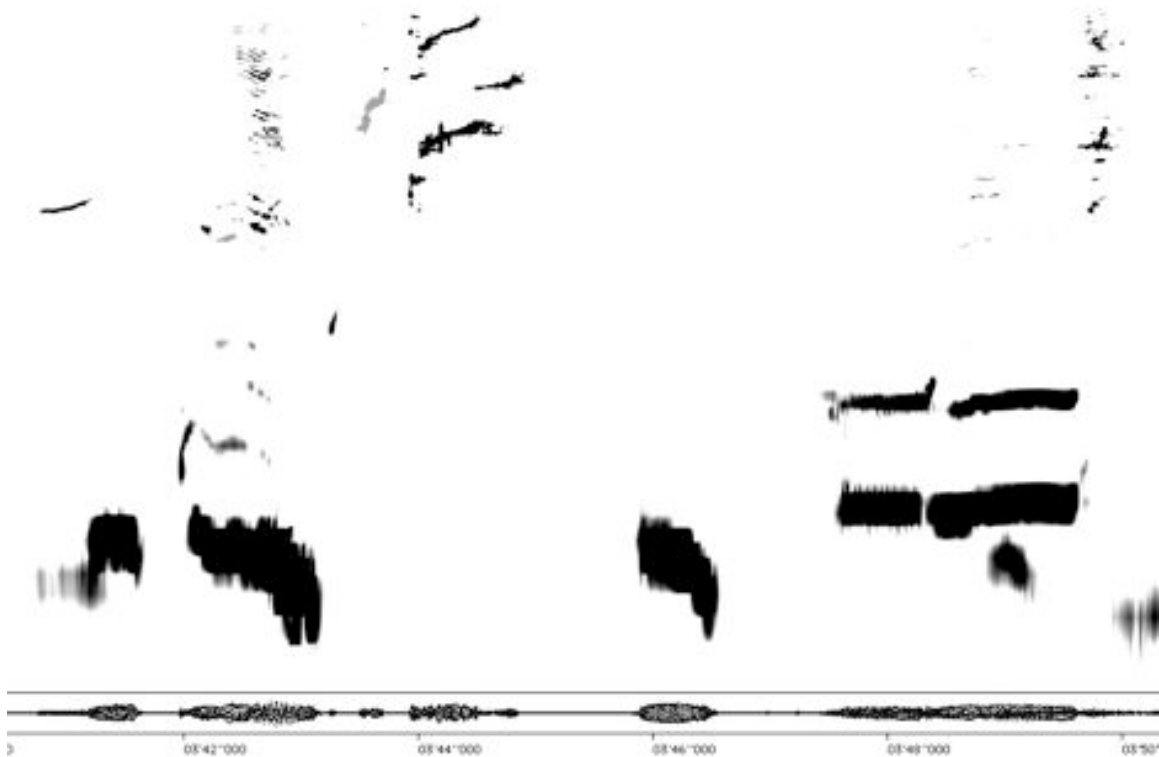
When I look at these dramatic warbly clarinet things at 3'24" and 3'28", I clearly see that something has happened to me here. I don't know if I am musically becoming a whale, but I have definitely been driven by the encounter to wail in a whole new way. It does look a bit like the klezmer madness of my ancestors, but an octave too high, way up at 2800Hz (F7).



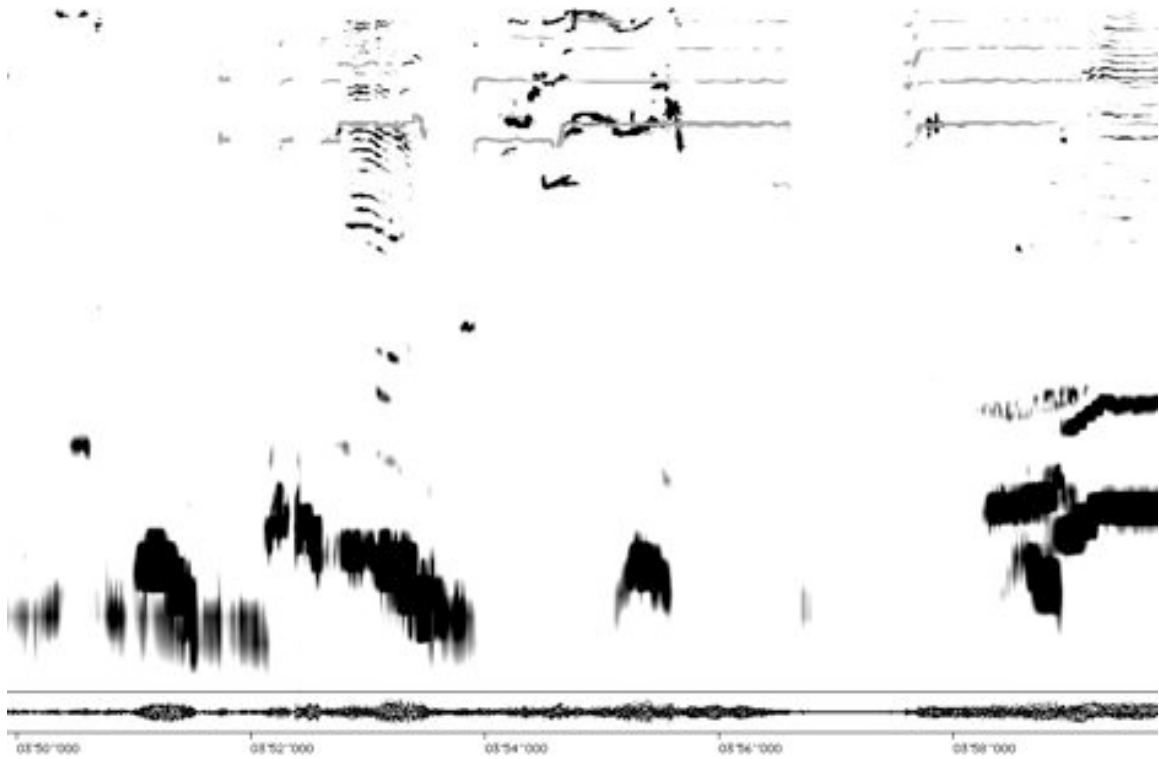
At this point the rest of the crew was ready to throw me off the ship. At 3'33" the whale is matching with a new kind of high squeak we have not previously heard. I wasn't sure before but now I am convinced that this animal is modifying his song in response to mind, a musical result that is a true surprise. This new and nearly painful shriek is, for me, the climax of this alien musical encounter.



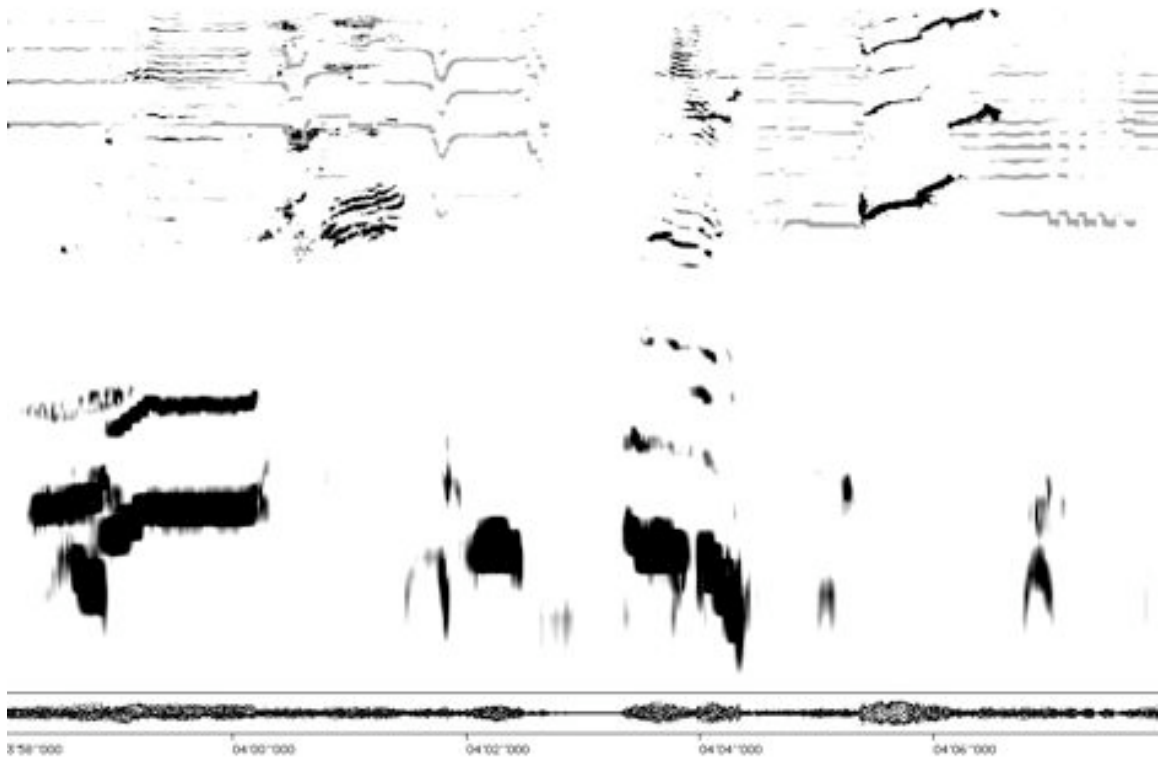
When something similar recurs between 3'43" to 3'44", I can no longer quite tell, either by ear or on the page, which is clarinet and which is whale.



And at 3'55", for the first time, the held out notes of clarinet and whale occur in tandem, like some kind of high altitude harmonic choir.



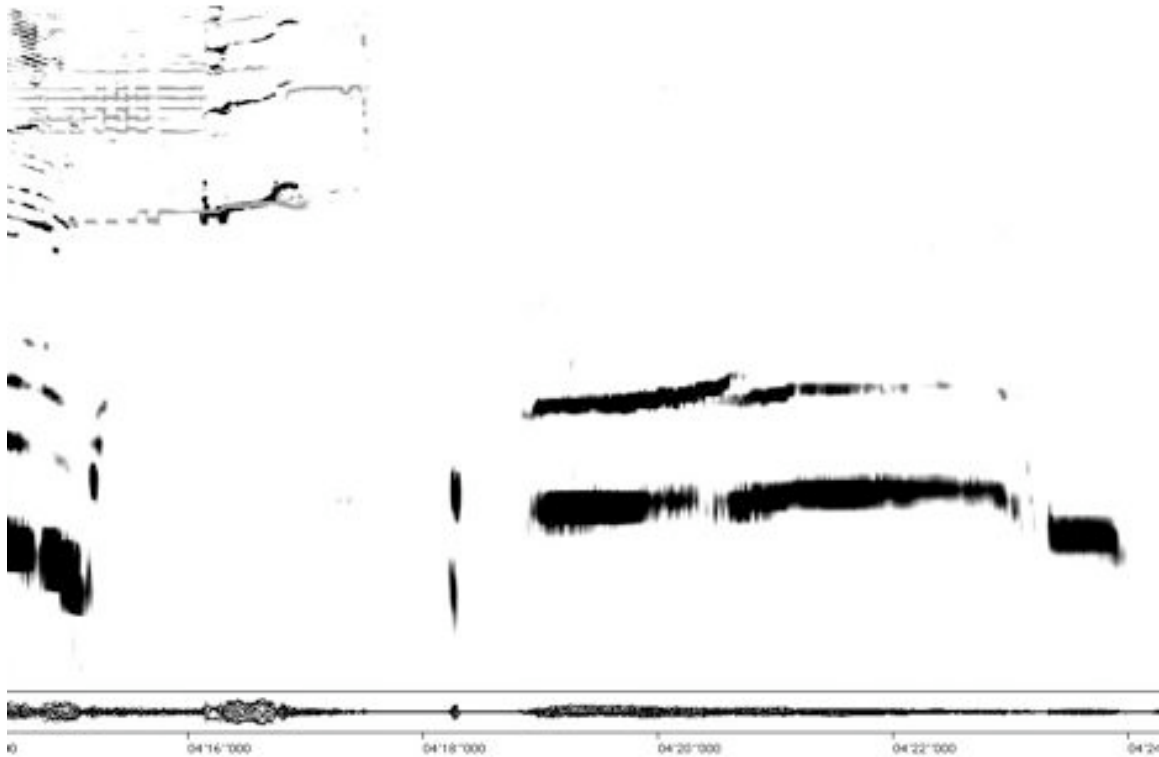
After a bit of further matching the whale makes a high growl at 4'01" that looks like a fingerprint on the sonogram, and the overlapping continues.



And on the following page the whale slows down his low phrases to his more usual tempo. Perhaps he is no longer so excited by this strange new clarinet sound.



From a low trill the whale upsweeps in and I join in with a final new shriek. The whale stretches out his final moan and is back to his usual self.



The remaining eight minutes of the duet are less dramatic, but there are still moments where the whale seems to change the pacing and nature of his phrasing in relation to clarinet sounds. Since this is a musical, not a scientific experiment, I am sorry I do not have enough data to be conclusive. But I do think it is relevant that a high percentage of scientists I played the above recording for, all of whom were familiar with the official line that humpback whales do not reliably respond to human sounds, were shocked by what they heard.

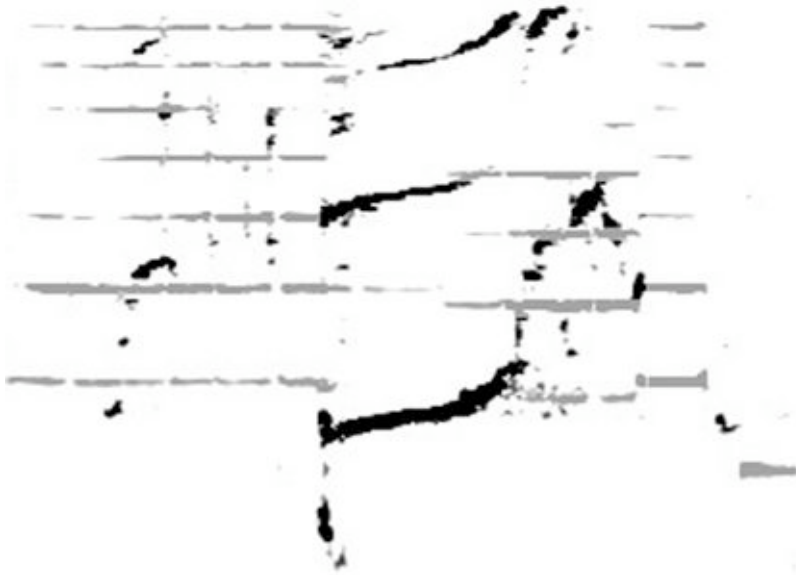
The shock might wear off once they begin to try to explain what they heard, but I believe the music is still there. Back on the boat, the rest of the humans on board got tired of these strange clarinet squeaks, and eventually some jumped in the water to hear the underwater mix for themselves, and the whale didn't seem too please with that and slowly moved away.

The engineer listening in on the hydrophones shouted out "David, stop playing, I need to adjust this equipment," but I told him, "Kent, I stopped a few minutes ago." Noonan turned to me and was taken aback. By now, at least to Kent, the whale was sounding as much like a clarinet as the clarinet was trying to sound like a whale. My music had become whale-like, the people could stand it no longer! One wonders if they had tossed me overboard as the pirates did to Arion in ancient Greece, (Mâche, 1992) would the whales have saved me and carried me safely to shore! Luckily I didn't have to find out, as my crew was exemplary in their assistance in my strange research and cannot be thanked enough.

## THE BEST MOMENTS OF INTERACTION

Throughout this duet are several clear examples where the whale seems to match the clarinet. Several of my favorites are enlarged here:

at 2'50", where the whale is striving to match the steady clarinet pitch:



3'31", where my whale-like wail garners a never-previously heard squeaky response:



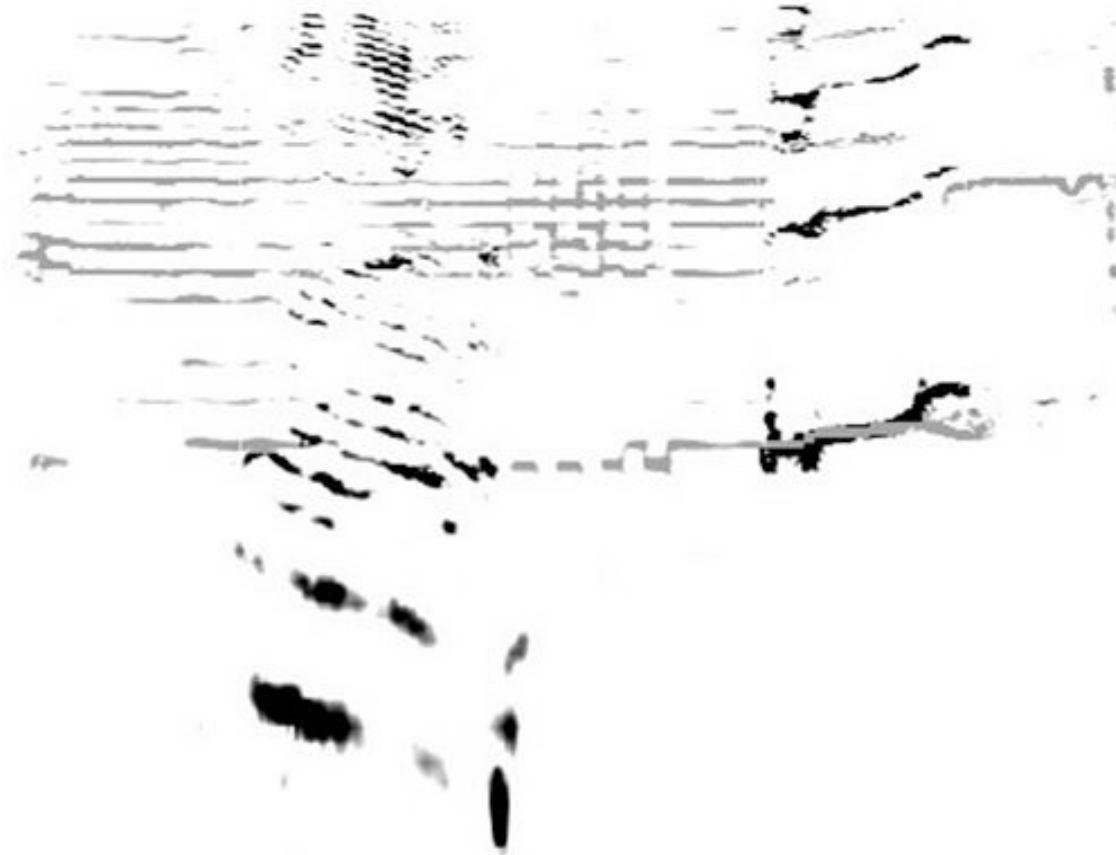
3'51", where the whale dares to match my sound as I am playing it. He can't quite hold the pitch but he is wavering up and down around it:



At 3'58" I am now playing wavering tones as he has taught them to me, he responds with a gritty growl:



Finally, at 4'06" he joins in with my steady note by uttering a deep, complex boom, then after my riff of discrete pitches he comes in with a whistle that finally matches me truly in tune, then I end with that new whale wail I have learned during this performance:



## CONCLUSION

As I reflect on the visualization of this experience, which seems to clearly reinforce my hunches that the whale was listening and trying to match me, I remember what I have learned from many years jamming with birds. Most birds have their own set and specific songs, and when they hear a clarinet, if they respond at all, it will be with their own well-known tunes. Even a bird with a vast repertoire like a nightingale or a mockingbird is going to use its own licks when and if he plays along with you. It has been well-documented that male nightingales have a territorial manner of singing along with other nearby male birds: They either interrupt what they hear by overlapping their own rhythms, as if in an attempt to jam the signal. Or they wait until the rival bird is done and then fill in the space with their song. Or, they might just continue singing as if no one else is there. This third option, clearly ignoring the other bird's song, is seen by some researchers as the strategy used by the top bird in an area. He's so alpha he couldn't care less what anyone else is doing. (Naguib and Kipper, 2005)

In contrast, the mockingbird, although quite territorially expressive, chasing and fighting with other males who come near, does not use song as a territorial display. And they sing and sing, even through the winter, when mating is not likely to happen. So it is less clear why this species needs such a complex song. They are also not known to interact much with human musicians or other bird sounds. They're deep into their own solo music...

But this whale seemed clearly to be matching my sounds. Should I be surprised? Spending enough time with whale scientists, they taught me to be skeptical of everything I saw and heard involving whales. Yet there was much disagreement among them, even as to the basic issues in their discipline. Peter Tyack told me that the field trusts observation and raw data too much, that there aren't good enough theories out there to explain whales need to sing so much and constantly evolve their song in a group way. Sal Cerchio told me that the problem with whale music studies is that people just throw out too many crazy theories and promote them as if they had enough evidence to back them up, which they rarely do. So does the field need better theories or better data? Probably both.

No one disagrees with the basic fact that, unlike any other species we know of, male humpback whales constantly change their song, and yet every whale seems to be singing the same song at the same time. How is the song changing then? The best evidence we have of hearing a change suddenly appear comes from a one page paper in *Nature* by Michael Noad, who reports that at least one, maybe a few Indian Ocean humpback whales from the West Coast of Australia got lost one season and turned up in his research area off of Australia's East Coast, in the South Pacific Ocean. They arrived with a completely different song, and in a matter of weeks all those Pacific whales had switched to the Indian Ocean song. (Noad et al, 2000) Is the drive for innovation so strong in this species that any new tune is going to displace the one in action before? This observation suggests it. But the new song probably has to have some particular qualities that we do not know to really become popular. Just as the music industry cannot manufacture a hit, we do not know what makes a catchy whale tune. But there must be some riffs they like and others they do not, explaining why some units stay in the humpback repertoire for decades and other come and go in a matter of months or years.

So if a whale has a penchant to learn from another whale, and be able to take on a new sound very quickly, then *of course* if he hears a clarinet out of the deep blue he's going to try the new sound on for size! Not only should I not be surprised that the whale is imitating me, I should expect it. If he didn't do it, then I would want to question the theory that whales learn songs from other whales. The sounds I was playing were well within the range of possible notes a humpback whale could make. So he tried them on for size.

Would this whale retain some of my phrases, work them into his repertoire? If he did, and all the whale have this real need for a new song that rapidly takes over the airwaves, then in a few months I might hear some of my motifs incorporated as new units in the song of the humpback whale. That would indeed be the highest compliment an interspecies musician could receive. Not praise from one's peers, but a piece of my music in the group mind of the whales.

I imagine it would take a lot more time playing the same phrases for the whales. Jim Darling told me he would like to get a permit to do that kind of research, but he doubts the Office of Marine Mammals would grant it—too much meddling in things we know little about! (Rothenberg, 2008) But already there is no doubt that the whale's live music has influenced what *I* play. Performing along with a whale, I try to inhabit the rhythm and shape of the song which a written or printed description cannot contain.

“Get inside the whale,” said George Orwell. “Or admit that you are already there.” There is music in nature, and the moment we admit it the surrounding world seems all the more accessible to us, and we have no choice to work as hard as we can to save it, if only to be able to understand it before it is gone.

We have worked to save the whales through awareness and love of their songs. Let us continue to work on this path and make beautiful music together.

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