

(Greenewalt, 1968) but no function for it was known (Sturdy and Mooney, 2000). In songbirds, these two voices with their respective harmonics are often not activated simultaneously but two voices are obvious in the large penguins and generate a beat pattern that varies between individuals.

Among the 17 species of penguins, only the *Aptenodytes* genus employs two frequency bands (Robisson, 1992b). Both *Aptenodytes* species, the emperor and the king penguins, produce a signal consisting of two simultaneous series of harmonically related bands of slightly differing frequencies (on average 65 Hz for the emperor, Aubin *et al.*, 2000, and 25 Hz for the king, Robisson, 1992b), resulting in a two-voice call that produces audible “beats.” The two-voice system appears well suited for the environment in which it is used. We have done experiments with two voice signals broadcast through the colony and recorded at different distances (1, 8, 16 m). The recorded signals were then analyzed and the amount of degradation between the amplitude modulation of the beats and the true modulation existing in the call itself were compared (Fig. 10). We found that, although the true amplitude

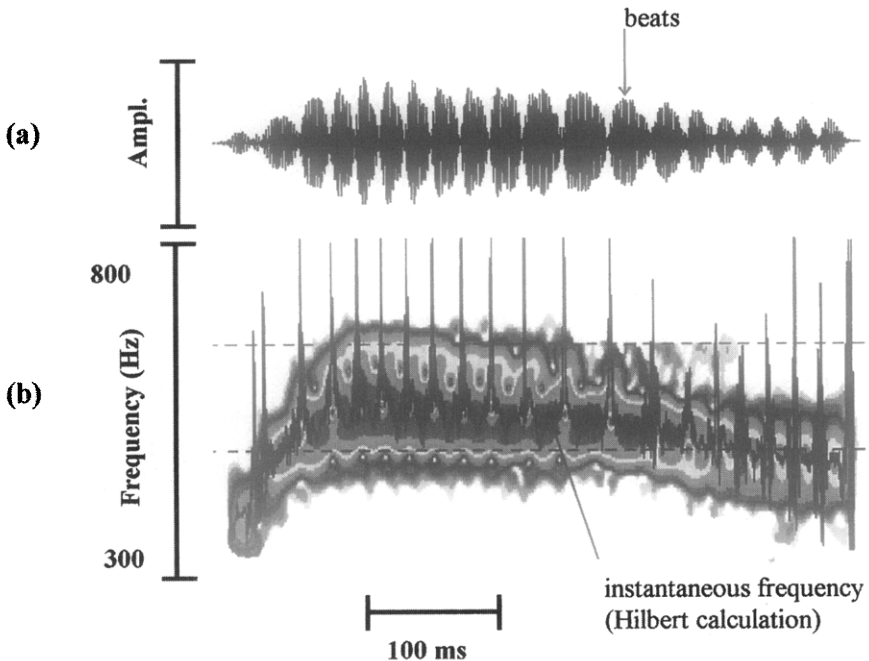


FIG. 10. King penguin display call: analysis of beats generated by the “two-voice system.” Only the fundamentals of one syllable are analyzed here. The periodic amplitude fluctuations [(a) oscillographic representation] coincide with the periodic frequency discontinuities [(b) spectrographic + instantaneous frequency representation] and allow quantification of the period of the beats generated by the two sources.