Supplement 2 - Multivariate analysis of putative fish sounds

Pulsed sounds

For pulsed sounds (Fig. S3 and Table S4 and S5), a discriminant analysis was performed for sounds with only 1 pulse and another for sounds with more than 1 pulse, as pulse period could only be measured in the later. The first and second dimensions explain 91.9 % of total variance and discriminates sounds with only 1 pulse mostly according to pulse duration, 75% frequency quartile and bandwidth (BW). This analysis showed a confusion matrix with an accuracy of 88 %. For the sounds with more than one pulse, the first three discriminant functions explained 31.9, 24.7 and 22.7 % of the variation (total = 79.2%), with the first dimension mostly representing changes in pulse period and pulse duration, second dimension mostly discriminating changes in frequency (maximum frequency slope), while the third dimension represents mostly the 25% and 75% frequency quartiles, and also number of pulses, which was an important criterium in the classification of these sounds. This analysis was able to distinguish ST 8, 29, 44 and 69 (correct identification rate > 80 %). However, the analysis showed difficulties in distinguishing some sound types (total accuracy of 61 %; see confusion matrix in Table S5). For instance, ST 21.1, 21.2 and 21.3 were not easily distinguished by the analysis (29 % of the sounds were confounded as other ST 21). Sound Types 15.1 and 12 showed several inconsistencies with misclassifications with multiple sound types (correct identification rate of 9 and 32 %, respectively).

Note that by plotting the averaged sound features of each sound type using the obtained discriminant dimensions (see Fig. S3) the analysis nearly groups sound types from the initially defined sound classes. Indeed, by applying a discriminant analysis considering the sound classes defined in Table S5 we obtain a total accuracy of 67 %. It is worth mentioning that the differentiation between these sound types has been done by aural and visual inspection of the sounds and, therefore, the measured features may lack some more subtle sound characteristics.

Continuous and noisy sounds

For continuous sounds (Fig. S4 and Table S6), the result of the analysis showed that, even though there were some misclassifications, the classified sounds were generally correctly separated. The first three discriminant functions explained 90.2, 6.5 and 1.8 % (total = 98.5%), with first dimension mostly representing changes in frequency (frequency peak contour maximum slope), second dimension discriminating the sound duration, 75% and 25% frequencies quartiles, while third dimension gave importance to the sound duration but also to sound bandwidth. Although the first dimension mostly represented changes in frequency peak contour maximum slope, the second dimension roughly separated frequency modulated from frequency non-modulated sound types. Confusion matrix shows a total accuracy of 62 % (Table S6).

Sound Type 57.2 was completely separated through the values of the first dimension (mostly driven by PFC max slope). Sound Types 55 and 57.1 are irregular sounds, and possibly because of that were difficult to distinguish from the other sound types. We found that several ST 59 and ST 65 sounds were misclassified as ST 24, and vice-versa. As stated before, these are similar sound types that were majorly distinguished by sound duration. It is possible that they represent sounds from the same or similar species. Several sounds of ST 60 were misclassified as ST 65, a tonal sound with the same dominant frequency.

Although the analysis can aggregate frequency modulated *vs.* frequency non-modulated sounds, looking into the sound type categories we observed that the noisy category was not easily distinguishable using the reported sound features (Fig. S4). Nevertheless, by applying a discriminant analysis considering the sound classes defined in Table S6 a total accuracy of 68 % was obtained.