# Limits of echolocation calls of european bats

| species | min QCF | max QCF | min PD* | max PD | max freq | min freq | peaks of typical IPI | min only for long calls curvature (m | dS(min/max) | swprate long(min/ma | swprate short (min/max | remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rhinolophus ferrumequinum** | 77 | 84 | 16 | 74 | | | 90 | NA | NA | NA | NA | no overlap with other rhinolophids |
| **Rhinolophus hipposideros** | 105 | 114 | 12 | 61 | | | 70 | NA | NA | NA | NA | 106-108 kHz could be 3 species |
| **Rhinolophus euryale** | 104 (102) | 109 | | | | | | NA | NA | NA | NA | in sympatric distribution euryale uses cf-calls 2-5 kHz lower than mehelyi but both species overlap considerably |
| **Rhinolophus blasii** | 92 | 98 | | | | | | NA | NA | NA | NA | no overlap with other rhinolophids |
| **Rhinolophus mehely** | 104 | 112 | | | | | | NA | NA | NA | NA | 104-112 kHz after Siemers et al 2005, young included, Sardinia after Russo et al. 2007 102 - 111 kHz. |
| **Myotis mystacinus** | 40 | 44 | 2 (1.5) | 4 (6.4) | 115 (125) | 35 (28) | 85 (SD=30) | -10 / 44 | -0.40 / 0.10 | -25 / -4 | -55 / -15 | Pulses < 4 ms mostly >-0.25 to linear, even convex |
| **Myotis brandtii** | 38 | 41 | 2.2 | 5.5 (7) | 120 (128) | 28-30 (26) | 88 (SD=28) | 7 / 50 | -0.40 / -0.08 | -30 / -4 | -60 / -15 | 5 ms normal, mostly curved (<-0.25), also in clutter |
| **Myotis emarginatus** | NA | NA | 2 (1.5) | 4.5 (5.8) | 160 (170) | 38 (30-48) | 70 (SD=24) | | | | | |
| **Myotis nattereri** | 43 | 51 | 2 (1.5) | 5 (10) | 140 (175) | 15 (7) | 80 (SD=40) | -15 / 34 | -0.34 / 0.29 | -30 / -7 | -100 / -40 | Often uses convex pulses when pulse duration is short. > 4 ms normal concave curvature in pulse (open environment) |
| **Myotis alcathoe** | NA | NA | 1.5 | 4 (5) | 130 (145) | 44 (40) | 81 (SD=28) | | | | | |
| **Myotis bechsteinii** | 48 | 52 | 2 (1.5) | 5 (11) | 140 | 40-28 (22) | 84 (SD=26) | | | | | clutter:soft, short FM, open:louder diagonal sweep with QCF at 50 kHz |
| **Myotis myotis/oxygnathus** | 26 | 29 | 3.5 (3) | 10 (12) | 90-100 (110) | 26 (25) | 105 (SD=18) | -8 / 58 | -0.32 / 0.06 | -23 / -1 | -35 / -10 | When longer than 4 ms: curved, shorter: linear; no clear terminal hook |
| **Myotis capaccini** | ? | ? | 2 | 6 (7) | 85-90 (100) | 32 (30) | 65 (SD=16) | | | | | |
| **Myotis daubentonii** | 35 | 39 | 2 (1.5) | 6 (7) | 85-90 (100) | 28 (25) | 75 (SD=30) | 23 / 45 | -0.41 / -0.30 | -14 / -3 | -55 / -20 | Pulses >2.5ms curved with clear final hook |
| **Myotis dasycneme** | 31 | 33 (36) | 2 | 10 (20) | 65-70 (85) | 28 (25) | 90-100 (SD=25) | 28 / 51-56 | -0.34-0.46 / -0. | -11 / 0 | -60 / -15 | Pulses >2.5ms curved with clear final hook, positioned after QCF part. |
| **Pipistrellus pipistrellus** | 41 | 50 (53) | 2.5 | 7.5 (10) | 100 (120) | 41 (40) | 90 and 165 | 60 / 77 | -1.6 / -0.75 | -85 / 0 | -85 / 2 | Attention, some short duration whispering pulses may have a QCF component up to 53kHz! |
| **Pipistrellus nathusii** | 37 (34) | 42 (43) | ? | 10 (11.5) | 90 | 37 (34) | 100 and 205 | | | | | Often uses many long duration (8 ms) pulses with QCF only. |
| **Pipistrellus kuhlii** | 37 (36) | 41 | ? | 9 (11) | 95 (100) | 37 (36) | 95 and 172 | | | | | SD of IPI in all pips IPI around 15ms |
| **Pipistrellus pygmaeus** | 53 (50) | 60 (65) | ? | 6.5 (9.7) | 100 (110) | 52 (50) | 75 and 165 | | | | | |
| **Hypsugo savii** | 32 (29) | 37 | ? | 12 (16) | 80 | 32 (29) | 95 and 175 | | | | | |
| **Miniopterus schreibersi** | 50 (48) | 53 (56) | ? | 11 (15) | 110 (115) | 50 (48) | 80 | 80 | | | | sometimes has a starting hook |
| **Nyctalus noctula (high)** | 21 | 24 | 4-5? | 20 (25) | 52 | 23 (21) | 140 and 230 | 70 | | | | |
| **Nyctalus noctula (low)** | 17 | 22 | NA | 18-25 (30) | 30 | 18 | 170, 300 and 450 | | | | | |
| **Nyctalus leisleri (high)** | 26 (24) | 28 (32) | 3-4? | 12 (16) | 70 | 26 (24) | 120 and 220 | | | | | most common, alternates less than N.noctula |
| **Nyctalus leisleri (low)** | 23 (21) | 24 | 10? | 17 (25) | 26 (30) | 23 (21) | ? | | | | | longest pulses often just horizontal stripe |
| **Nyctalus lasiopterus** | 16 (14) | 22 (23) | ? | 28 (40) | 50 | 16 (14) | 150 and 270 | | | | | |
| **Eptesicus serotinus** | 25 (23) | 28 | 3.5 | 12-14 (23) | 65 (77) | 25 (23) | 143 and 278 | 80 | | | | |
| **Eptesicus nilssoni** | 26 | 31 | 3.5 | 12-14 (18) | 65 (77) | 27 | 95, 195 and 300 | | | | | |
| **Vespertilio murinus** | 23 (21) | 25 (27) | 4.5 (4) | 16-18 (20) | 55 (60) | 23 (21) | 129, 240 and 336 | 65 | | | | |
| **Barbastella barbastellus (high)** | 42 | 48 | ? | 8 (11) | 48 | 32 (24) | 55-60 (SD=8) | | | | | starts with CF and then has terminal sweep |
| **Barbastella barbastellus (low)** | NA | NA | ? | 3 (4) | 36 (40) | 26 (25) | 92 and 180 | | | | | FM sweep, can have strong harmonics |
| **Plecotus auritus** | 20 | 26 | 0.5 | 3 (4) | 55 | 24 | 50 | | | | | Can shift its resonance optimum from pulse to pulse amplifying first or second harmonic specifically |
| **Plecotus austriacus** | 20 | 24? | 0.5 | 5 (6) | 45 | 20 | ? | | | | | Can shift its resonance optimum from pulse to pulse amplifying first or second harmonic specifically |
| **Tadarida teniotis** | 11 (8) | 15? | 8? | 20 (27) | 31 | 9 (8) | 1.4027E+11 | | | | | Overlap may exist with Nyct.lasiopterus |

*** with first harm intact**
**QCF = Quasi constant frequency**
**PD = Pulse Duration**
**IPI = Interpulse Interval**

in brackets extremest value recorded