

RECOMMENDED SURVEY METHODS MATRIX						
Bookmarks: Key to Matrix Values More Information About this Matrix						
BAT GROUPS		TYPE OF SURVEY				NOTES
		NETTING	ROOST	ACOUSTIC (passive)	ACOUSTIC + VISUAL (active)	
<i>Eptesicus fuscus</i>	Big brown bat	1	3	3	1	Netting- Capture: Readily captured in mist nets, but problematic in open areas, especially where water is abundant. ID: Morphologically distinct. Roost- Location: Easy to locate man-made roosts; difficult in most natural roosts (e.g., trees and rock crevices). Natural roosts dominate throughout much of range. Night roost surveys often effective. ID: Colonies often conspicuous, species easy to ID. Passive Acoustic- Detection: Easy. ID: subset of sequences diagnostic acoustic overlap with <i>Lasionycteris</i> and <i>Tadarida</i> . Active Acoustic- Visually distinctive in flight.
<i>Myotis californicus</i>	California myotis	1	4	3	1	Netting- Capture: Readily captured in mist nets. ID: Morphologically similar to <i>M. ciliolabrum</i> . Can be distinguished from <i>M. ciliolabrum</i> by combination of capture and recording of hand-release echolocation call. Roost- Location: Can be found in man-made roosts, but generally non-colonial and crevice-roosting; most roosts not man-made and difficult to find. Sometimes found in night roosts. ID: Requires handling for positive identification. Passive Acoustic- Detection: Easy. ID: Difficult to distinguish from <i>Myotis yumanensis</i> (50K Myotis). Active Acoustic: Flight behavior distinguishes it from <i>M. yumanensis</i> in most settings.
<i>Myotis evotis</i>	Long-eared myotis	1	3	2	2	Netting- Capture: Readily captured in mist nets at both aquatic and terrestrial sites. ID: Morphologically distinct except in areas of overlap with <i>M. auriculus</i> , <i>M. keenii</i> , or <i>M. septentrionalis</i> . Also similarity to <i>M. thysanodes</i> in some regions. Roost- Location: Can be detected in man-made roosts, but often cryptic; difficult in most natural roosts (e.g., trees and rock crevices). Natural roosts dominate. Sometimes in night roosts, particularly mines and bridges, although extent to which these features are used varies regionally. ID: Small colonies. Generally crevice roosting. Often requires handling for positive identification. Passive Acoustic- Detection: Intermediate intensity calls. ID: Subset of sequences diagnostic except in area of geographic overlap with <i>M. auriculus</i> , <i>M. septentrionalis</i> or possibly <i>M. keenii</i> . Also possible confusion under some habitat conditions with 40 kHz <i>Myotis</i> . Active Acoustic - May be helpful in distinguishing it from short-eared <i>Myotis</i> .
<i>Myotis keenii</i>	Keen's myotis	4	5	U	U	Netting- Capture: Difficult to find. Most netting records from known cave roosts. ID: Issues currently unresolved, but probably difficult to distinguish from <i>M. evotis</i> . Due to uncertainties regarding ID, morphometric data, hand-release calls, and wing-biopsy should be collected from all individuals. Roost- Location: Can be detected in caves and buildings, but difficult in tree roosts. Tree roosts probably dominate. ID: Small colonies and difficult to distinguish from <i>M. evotis</i> . Often requires handling for positive identification. Passive Acoustic- Detection: Presumably has intensity similar to <i>M. evotis</i> . ID: Issues currently unresolved, but likely difficult to distinguish from <i>M. evotis</i> . Active Acoustic- Unknown
<i>Myotis septentrionalis</i>	Northern myotis	3	3	2	2	Netting- Capture: More successful in interior forest than over water in eastern deciduous forest; harp traps set in gaps between trees effective in SD and WY. Occasionally captured over water. ID: Easy except where range overlaps with <i>M. evotis</i> . Roost- Location: Surveys for night roosts and hibernacula can be effective; day roosts under bark. ID: Very cryptic in day roosts. Requires handling for positive identification. Passive Acoustic- Detection: Intermediate intensity calls ID: Many sequences diagnostic, but overlap with other 40 K <i>Myotis</i> , particularly <i>M. lucifugus</i> . Also potential for confusion with <i>M. evotis</i> . Active Acoustic- May be helpful in distinguishing it from small -eared <i>Myotis</i> . Often flies in cluttered settings where ID can be difficult.
<i>Myotis thysanodes</i>	Fringed myotis	1	3	2	2	Netting- Capture: Readily captured in mist nets (often on secondary streams in northwestern portion of range). ID: Generally easy, but morphologically similar to <i>M. evotis</i> in some regions. Roosts- Location: Can be detected in man-made roosts, but difficult in most natural roosts (e.g., trees and rock crevices). Natural roosts dominate. Sometimes found in night roosts. ID: Small colonies and often in crevices. Requires handling for positive identification. Passive Acoustic- Detection: Intermediate intensity calls. ID: Many sequences/calls diagnostic. Possible confusion with <i>A. pallidus</i> . Active Acoustic- Flight behavior, in combination with call morphology, sometimes helpful.
<i>Myotis yumanensis</i>	Yuma myotis	1	2	3	1	Netting- Capture: Water-skimming foraging style makes this species highly vulnerable to capture in mist-nets set over still water. ID: Morphologically similar to <i>M. lucifugus</i> and <i>M. occultus</i> . Can be distinguished from <i>M. lucifugus</i> and <i>M. occultus</i> by combination of capture and recording of hand-release echolocation call. Roost- Location: Commonly in man-made roosts. Form large aggregations in night roosts (particularly bridges). Difficult to locate most natural roosts. ID: Highly colonial and easy to detect in man-made roosts.

						Requires handling for positive identification. Passive Acoustic-Detection: Easy to detect acoustically. ID: Difficult to distinguish from <i>M. californicus</i> , though some calls diagnostic (50K Myotis). Active acoustic- Flight behavior, particularly water skimming, distinctive.
<i>Antrozous pallidus</i>	Pallid bat	1	3	2	1	Netting- Capture: Fly low to ground and readily captured in nets (often in upland habitats). ID: Morphologically distinct. Roost- Location: Easy to detect colonies in man-made roosts; difficult in most natural roosts (e.g., trees and rock crevices). Frequently uses man-made roosts (mines, bridges, buildings) in parts of its range. Often found in night roosts, especially mines and bridges. ID: Roost conspicuously, easy to ID. Guano with characteristic culled insect parts (particularly Jerusalem crickets and scorpions) often distinctive. Passive Acoustic-Detection: Easy to detect acoustically. ID: Subset of calls diagnostic, particularly if it gives a "directive" call. Active acoustic- Visually distinctive.
<i>Idionycteris phyllotis</i>	Allen's big-eared bat	3	3	2	2	Netting- Capture: Captured infrequently in mist nets; show loyalty to particular water sources, but may be difficult to locate in initial surveys. ID: Morphologically similar to <i>C. townsendii</i> . Roost- Location: Easy to detect in man-made roosts (e.g., mines); difficult in natural roosts (e.g., trees, rock crevices). ID: Easy: roost in clusters on open surface (e.g., domes of mines). May be confused with <i>C. townsendii</i> . Passive Acoustic- Detection: Easy to detect acoustically (with low frequency microphone). ID: Most sequences diagnostic, except can be difficult to distinguish from <i>E. maculatum</i> . Geographic overlap with <i>E. maculatum</i> throughout much of its range. Highly distinctive social call. Active Acoustic- Can be difficult to distinguish from <i>E. maculatum</i> .
<i>Myotis auriculus</i>	Southwestern myotis	1	5	U	U	Netting- Capture: Readily captured in mist nets. ID: Morphologically distinct except where range overlaps with <i>M. evotis</i> . Roost- Location: Easy to detect in man-made roosts; difficult in most natural roosts. Likely that natural roosts dominate. ID: Roost in small groups. Requires handling for positive identification. Passive Acoustic-Detection: Easy to detect acoustically. ID: Probably many sequences diagnostic except in area of geographic overlap with <i>Myotis evotis</i> . Active Acoustic- Visual cues will not help distinguish from <i>M. evotis</i> .
<i>Myotis ciliolabrum</i>	Small-footed myotis	2	3	4	4	Netting- Capture: Readily captured in nets in some portions of its range; but vulnerability to netting may vary regionally. ID: Morphologically similar to <i>M. californicus</i> . Can be reliably identified using combination of morphological and acoustic data. Roost- Location: Predominantly non-colonial. Frequently in mines, but natural roosts likely dominate, and difficult to find. Sometimes found in night roosts. ID: Roost in small groups. Requires handling for positive identification. Passive acoustic- Detection: Easy to detect acoustically. ID: Not currently distinguishable from other 40K Myotis. Active acoustic- Can sometimes be distinguished when observed in flight, but requires experience.
<i>Myotis lucifugus</i>	Little brown myotis	2	3	4	3	Netting- Capture: Readily netted in some areas; net-avoidant in others. ID: Morphologically similar to <i>M. yumanensis</i> and <i>M. occultus</i> . Can be reliably identified using combination of morphological and acoustic data. Roost- Location: Frequently in man-made roosts (mines, bridges, buildings) in parts of its range. Difficult to find in most natural roosts (e.g., trees and rock crevices). Sometimes found in night roosts. ID: Highly colonial and easy to detect in man-made roosts. Often requires handling for positive identification. Passive Acoustic- Detection: Easy to detect acoustically. ID: Some calls/sequences diagnostic, though probably not distinguishable from <i>M. occultus</i> in areas of geographic overlap. Difficult to distinguish from other 40K Myotis. Active Acoustic- Flight behavior sometimes distinctive, particularly over water.
<i>Myotis occultus</i>	Arizona myotis	2	3	4	4	Netting- Capture: Fairly easy to capture in nets. ID: May be difficult to distinguish from <i>M. lucifugus</i> in areas of overlap. Roost- Location: Roost in man-made roosts, but natural roosts dominate. Can often be found in night roosts. ID: Easy to detect in man-made roosts; difficult in most natural roosts. Often requires handling for positive identification. Passive acoustic- Detection: Easy to detect acoustically. ID: Issues currently unresolved but probably difficult to distinguish acoustically from other 40K Myotis. Active Acoustic- Difficult to distinguish visually.
<i>Myotis volans</i>	Long-legged myotis	2	2	4	3	Netting- Capture: Effectiveness of netting varies regionally, and setting makes a difference. ID: Morphologically distinct. Roost- Location: Can be found in man-made roosts; difficult in most natural roosts. Natural roosts dominate. Often found in night roosts. ID: Requires handling for positive identification. Passive Acoustic- Detection: Easy to detect acoustically. ID: Issues currently unresolved with other 40K Myotis. Active Acoustic- Flight behavior can be distinctive (long tail membrane).
<i>Tadarida brasiliensis</i>	Mexican free-tailed bat	2	1	1	1	Netting- Capture: While sometimes captured in mist nets, this species flies high and is generally more abundant than net captures would suggest. ID: Generally distinctive, but potentially confused with <i>N. femorosaccus</i> . Roost- Location: Highly colonial and easy to detect in man-made roosts; difficult in most natural roosts. Natural roosts (e.g., cliff roosts) dominate in large portion of range. Commonly in man-made roosts in portion of its range. ID: Easy to locate and ID in most roosts. Guano and odor distinctive. Passive acoustic- Detection: Easy to detect acoustically. ID: Some calls overlap with other species (<i>Lasionycteris</i> , <i>Eptesicus</i> , <i>L. cinereus</i> , <i>N. femorosaccus</i>), but fair proportion are diagnostic. In most settings this would be the easiest way

						to detect the species. Active Acoustic- Visually distinctive except where overlaps with <i>N. femorosaccus</i> .
<i>Lasionycteris noctivagans</i>	Silver haired bat	1	5	4	2	Netting- Capture: Vulnerability to net capture varies with habitat, but generally quite susceptible to capture. Captured over water sources (large and small). ID: Morphologically distinct. Roost- Location: Very difficult to locate in natural roosts (e.g. trees and snags). ID: Unlikely to locate via roost search but, can be distinguished visually in flight upon exit. Passive Acoustic- Detection: Easy to detect acoustically. ID: Some calls distinctive, but overlap with <i>Tadarida</i> and <i>Eptesicus</i> . In areas without <i>Tadarida</i> , many sequences are diagnostic. Active Acoustic- With experience can be distinguished visually in flight.
<i>Lasiurus blossevillii</i>	Western red bat	3	5	2	1	Netting- Capture: Sometimes captured in mist nets, but foraging areas often not suitable for netting (e.g., over large water sources). ID: Morphologically distinct except where overlaps with <i>L. borealis</i> . Roost- Location: Non-colonial. Very difficult to locate tree roosts. ID: Difficult to locate bats in foliage, easy to ID except where overlaps with <i>L. borealis</i> . Passive acoustic- Detection: Easy to detect acoustically. ID: Most sequences diagnostic in areas without <i>L. borealis</i> . In areas with <i>L. borealis</i> , extensive acoustic overlap, but probably distinguishable statistically. Some acoustic overlap with <i>P. hesperus</i> . Active Acoustic- Distinctive in flight except in areas with <i>L. borealis</i> .
<i>Lasiurus borealis</i>	Eastern red bat	2	5	2	1	Netting- Capture: Readily captured over water and in side channels in eastern U.S. ID: Morphologically distinct except where overlaps with <i>L. blossevillii</i> . Roost- Location: Difficult to locate tree roosts. ID: Difficult to locate bats in foliage, easy to ID except where overlaps with <i>L. blossevillii</i> . Passive Acoustic- Detection: Easy to detect acoustically. ID: Most sequences diagnostic in areas without <i>L. blossevillii</i> . In areas with <i>L. blossevillii</i> , extensive overlap but probably distinguishable statistically. Active Acoustic- Distinctive in flight except in areas with <i>L. blossevillii</i> .
<i>Lasiurus cinereus</i>	Hoary bat	3	5	2	1	Netting- Capture: Fly high; often under-represented in net captures. Often foraging in areas that cannot be feasibly netted. ID: Morphologically distinct. Roost- Location: Non-colonial. Very difficult to locate tree roosts. ID: Difficult to locate bats in foliage but easy to distinguish from other species. Passive Acoustic- Detection: Easy to detect acoustically. ID: Many calls diagnostic throughout much of its range; subset of calls overlap with <i>Tadarida</i> and <i>N. femorosaccus</i> . Active Acoustic- Distinctive in flight.
<i>Lasiurus xanthinus</i>	Southern yellow bat	3	3	2	1	Netting- Capture: Readily captured in some habitats; apparently difficult in others. Not enough known about appropriate habitats. ID: Morphologically distinct. Roost- Location: Difficult to locate tree roosts. Can sometimes be located by monitoring palm trees at emergence time. ID: Difficult to observe in roost, but easy to ID during emergence from roost. Passive acoustic- Detection: Easy to detect acoustically. ID: Most sequences diagnostic, but some acoustic overlap with <i>L. borealis</i> and <i>E. fuscus</i> . Active acoustic- Reasonably distinctive in flight.
<i>Euderma maculatum</i>	Spotted bat	3	5	2	1	Netting- Capture: Can be effective where water is a limiting factor in xeric conditions, although netting is not effective in many portions of range. ID: Morphologically distinct. Roost- Location: Non-colonial, cliff-roosting; very difficult to locate and generally inaccessible. ID: Unknown; no roosts have been visually inspected; only locations have been from a distance using radio-telemetry. Passive acoustic- Detection: Easy to detect acoustically (with microphones sensitive to audible frequencies). Calls are audible to many people ID: Most sequences diagnostic, except in areas of geographic overlap with <i>I. phyllotis</i> . Active acoustic- Difficult to distinguish from <i>I. phyllotis</i> ; otherwise distinctive in flight.
<i>Pipistrellus hesperus</i>	Western pipistrelle	2	5	1	1	Netting- Capture: Captured in nets fairly readily, although often fly high. ID: Morphologically distinct. Roost- Location: Predominantly cliff-roosting. Some roosting in man-made structures, particularly mines. ID: Usually non-colonial or small colonies. Can be identified visually at very close range. Passive acoustic- Detection: Easy to detect acoustically. ID: Most calls diagnostic, although some overlap with <i>L. blossevillii</i> . Active Acoustic- Visually distinctive.
<i>Eumops perotis</i>	Western mastiff bat	3	3	1	1	Netting- Capture: Effectiveness of netting varies regionally. Have been netted where open flight paths are evident, or water is limiting. Forage at considerable heights; captured at drinking sites. ID: Morphologically distinct. Roost- Location: Most roost in cliffs and are highly inaccessible; quite frequently in building roost. Can sometimes be found by surveying for guano and listening for loud chatter along base of cliffs. ID: Generally requires monitoring at emergence. Passive Acoustic- Detection: Easy to detect acoustically (better with low frequency microphone). Calls in the audible range for many people. ID: Calls diagnostic. Active Acoustic- Distinctive except in areas of overlap with <i>E. underwoodi</i> .
<i>Eumops underwoodi</i>	Underwood's mastiff bat	3	U	1	1	Netting- Capture: Logistically difficult, requiring net sets over large bodies of water. ID: Morphologically distinct. Roost- Poorly known; one study radiotracked to saguaro cactus. Passive Acoustic- Detection: Easy to detect acoustically (better with low frequency microphone). Calls in the audible range for many people. ID: Calls diagnostic except

						where range overlaps with <i>N. macrotis</i> . Active Acoustic- Distinctive except in areas of overlap with <i>E. perotis</i> and <i>N. macrotis</i> .
<i>Nyctinomops femorosaccus</i>	Pocketed free-tailed bat	3	3	2	1	Netting- Capture: Effective in low-elevation canyon sites, and near known roosts. ID: Morphologically distinct, but potentially confused with <i>T. brasiliensis</i> . Roost- Location: Roosts often inaccessible. Roosts primarily in cliffs. Sometimes possible to find roosts by surveying for guano and listening for chatter at base of cliffs. ID: Generally requires monitoring at emergence. Passive Acoustic- Detection: Easy to detect acoustically; calls in the audible range for some people. ID: Subset of calls/sequences diagnostic, some overlap with both <i>Tadarida</i> and <i>L. cinereus</i> . Active Acoustic- Useful for distinguishing from <i>L. cinereus</i> .
<i>Nyctinomops macrotis</i>	Big free-tailed bat	3	5	1	1	Netting- Capture: Records extremely limited suggesting serious challenges. ID: Morphologically distinct. Roost- Location: Generally cliffs and rock crevices; often inaccessible. Also known to use building and tree roosts. Guano deposits and chatter can potentially be used to locate roosts, but generally not effective. ID: Generally requires monitoring at emergence. Passive Acoustic- Detection: Easy to detect acoustically (best with low frequency microphone); calls in audible range for some people. ID: Most calls diagnostic, but overlap with <i>E. underwoodi</i> and possibly <i>E. perotis</i> . Species poorly known. Active Acoustic- Indistinguishable from <i>Eumops</i> in flight.
<i>Choeronycteris mexicana</i>	Mexican long-tongued bat	3	3	U	4	Netting- Capture: Effectiveness of netting depends on habitat type. ID: Morphologically distinct. Roosts- Location: Difficult to find. ID: Easy to detect in roost. Passive Acoustic- Detection: Difficult to detect acoustically. ID: Issues currently unresolved. Active Acoustic- Indistinguishable from <i>Leptonycteris</i> species, except at very close range (e.g. hummingbird feeders).
<i>Leptonycteris curasoae</i>	Lesser long-nosed bat	3	1	U	4	Netting- Capture: Effectiveness of netting depends on habitat type. ID: Morphologically distinct. Roost- Location: Roosts in mines and caves; highly colonial. ID: Easy to detect and ID in roost except in areas of overlap with <i>L. nivalis</i> . Passive Acoustic- Detection: Difficult to detect acoustically. ID: Issues currently unresolved. Active Acoustic- Indistinguishable in flight from <i>L. nivalis</i> and <i>Choeronycteris</i> , except possibly at very close range (e.g. hummingbird feeders).
<i>Leptonycteris nivalis</i>	Big long-nosed bat	3	1	U	4	Netting- Capture: Effectiveness of netting depends on habitat type. ID: Morphologically distinct. Roost- Location: Roosts in mines and caves; colonial. ID: Easy to locate and ID, except in areas of overlap with <i>L. curasoae</i> . Passive Acoustic- Detection: Unknown, but presumably difficult to detect acoustically. ID: Issues currently unresolved. Active Acoustic- Indistinguishable in flight from <i>L. curasoae</i> and <i>Choeronycteris</i> , except possibly at very close range (e.g. hummingbird feeders).
<i>Macrotus californicus</i>	California leaf-nosed bat	4	1	4	4	Netting- Capture: Avoids mist nets. ID: Morphologically distinct. Roost- Location: Most effectively found by searching for colonial roosts, primarily in mines and caves. ID: Easy to locate and ID in roost. Passive Acoustic- Detection: Difficult to detect acoustically. ID: Subset of calls diagnostic. Active Acoustic- Can ID visually at close range.
<i>Mormoops megalophylla</i>	Ghost-faced bat	2	2	1	1	Netting- Capture: Readily captured in nets, but very delicate and often die. Suggest using harp traps. ID: Morphologically distinct. Roost- Location: Roosts in caves ID: Presumably easy to locate and ID when present. Passive Acoustic- Detection: Easy to detect acoustically. ID: Calls highly diagnostic. Active Acoustic- So distinctive acoustically that visual observation does not contribute to ID.
<i>Corynorhinus townsendii</i>	Townsend's big-eared bat	3	2	4	4	Netting- Capture: Effective at avoiding mist-nets. ID: Morphologically similar to <i>I. phyllotis</i> . Roost- Location: Most effectively found by searching for colonial roosts, in mines and caves. Roosts in buildings in coastal portion of range. Some portions of range, particularly Canada and some desert areas, roosts very difficult to locate. ID: Easy to locate and ID in roost. Passive Acoustic- Detection: Difficult to detect acoustically, low intensity calls ("whispering bat"). ID: Calls, when detected, are diagnostic. Active Acoustic- Visually distinctive in most settings.

<i>Myotis velifer</i>	Cave myotis	2	1	3	3	<p>Netting- Capture: Limited usefulness in some habitats. ID: Morphologically distinct, but potentially confused with <i>M. occultus</i> or <i>M. lucifugus</i>. Roost- Location: Primarily in caves and rock crevices, but occasionally in buildings. ID: Roost colonially; can be confused with other colonially roosting Myotis and <i>E. fuscus</i>. Passive Acoustic-Detection: Easy to detect acoustically. ID: Overlap with other 40K Myotis. Acoustic ID best in areas without other 40 kHz Myotis. Active Acoustic- Visually similar to other 40 kHz Myotis.</p>
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KEY	
1	Preferred or highly effective
2	Effective in most habitats
3	Effective in some habitats
4	Presents serious challenges
5	Generally not effective
U	Unknown