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MINIREVIEW

Update on Novel Taxa and Revised Taxonomic Status of Bacteria Isolated from Nondomestic Animals Described in 2018 to 2021

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ABSTRACT Revisions and new additions to bacterial taxonomy can have a significant widespread impact on clinical practice, infectious disease epidemiology, veterinary microbiology laboratory operations, and wildlife conservation efforts. The expansion of genome sequencing technologies has revolutionized our knowledge of the microbiota of humans, animals, and insects. Here, we address novel taxonomy and nomenclature revisions of veterinary significance that impact bacteria isolated from nondomestic wildlife, with emphasis being placed on bacteria that are associated with disease in their hosts or were isolated from host animal species that are culturally significant, are a target of conservation efforts, or serve as reservoirs for human pathogens.

KEYWORDS bacterial taxonomy, veterinary microbiology

Understanding diseases of wildlife is important for a variety of reasons. Many human populations depend on wildlife for food and livelihoods, while maintaining wildlife diversity and protecting animal health are crucial for maintaining ecosystem health (1–5). Microbes are fundamental to animal and ecosystem health both positively and to its detriment (6). Additionally, microbes can move among wildlife, domestic animals, and humans and, as the SARS-CoV-2 pandemic clearly demonstrated, ultimately have the potential to significantly impact human health (7–9). Moreover, historic accounts have clearly demonstrated this paradigm with respect to *Yersinia pestis* (10).

In order to satisfy an unmet need in clinical veterinary microbiology practice, this taxonomy minireview focuses on bacteria isolated from nondomestic wildlife, with emphasis being placed largely on bacteria that cause disease in animal hosts or are found in animals that could serve as reservoirs for human disease. Novel bacterial taxa and nomenclature revisions relative to veterinary medicine were searched from 2018 through 2021. Of the >350 novel taxa observed, around 40% were related to prokaryotes derived from nondomestic wildlife animals. These data, along with notations of revised taxonomy relative to prokaryotes derived from these wildlife hosts, are presented in the current report. Other taxonomic changes relative to organisms derived from domestic animals (11) and aquatic hosts (12) are presented in other reports in this issue of the *Journal of Clinical Microbiology*.

MATERIALS AND METHODS

Valid and effectively published novel and revised taxa pertinent to prokaryotic species must satisfy two requirements set forth by the International Committee on Systematics of Prokaryotes within the International Code of Nomenclature of Prokaryotes (13). First, original investigations are published in the *International Journal of Systematic and Evolutionary Microbiology* (IJSEM). One example is provided by Niu et al. (14). In addition, type strains are to be deposited into recognized culture collections in two separate nations.

As an alternative to primary publication in the IJSEM, studies may be published in another journal, with later acceptance by the IJSEM. One previous example relative to nondomestic animal-derived bacteria is the effective description of *Microbacterium gilvum* (15), with subsequent acceptance on an IJSEM

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validation list (16). Six times per year, the IJSEM publishes papers that are now entitled *Valid Publication of New Names and New Combinations Effectively Published Outside the IJSEM*. To be considered for inclusion in a validation list, authors must submit a copy of the previously published manuscript to the editorial office of the IJSEM for confirmation that all elements necessary for valid publication (including culture collection deposition) have been met. It must be noted that taxa within a primary publication or in validation lists may be subject to reclassification on the basis of a synonym designation or transfer to another genus. We attempt to capture additional revisions in this report.

In such a fashion, journals that have recently published studies providing an effective description of nondomestic wildlife animal-derived novel taxa that may be relevant for the practice of clinical veterinary microbiology include *Applied and Environmental Microbiology*, *Archives of Microbiology*, *Avian Diseases*, *Diseases of Aquatic Organisms*, *Frontiers in Microbiology*, *MicrobiologyOpen*, *PLoS Neglected Tropical Diseases*, *Research in Microbiology*, *Standards in Genomic Sciences*, and *Systematic and Applied Microbiology*. Journals that have recently published studies reflecting revisions in prokaryotic taxonomy relative to nondomestic animal hosts include *Antonie Van Leeuwenhoek* and *Frontiers in Microbiology*.

All issues of the IJSEM published from January 2018 through December 2021 (including 24 validation lists) were manually searched for original articles describing new species taxonomy or accepted changes in taxonomic nomenclature. This audit was further filtered by organisms recovered from nondomestic wildlife animals. Not included within the definition of nondomestic wildlife animals are companion animals, animals found in agricultural settings, and farmed avian species.

RESULTS AND DISCUSSION

A compilation of novel taxa recovered from nondomestic wildlife animal sources stratified by Gram reaction, cellular morphology, and oxygen growth requirements is presented in Table 1. Correct and updated *Enterobacterales* family designations (17) for selected taxa are concomitantly provided. It should be noted that in Table 1, a subset of biochemical testing results was derived using methods that are potentially time-consuming, antiquated, and/or not routinely available in veterinary microbiology laboratories; furthermore, a definitive identification of other novel taxa may necessitate matrix-assisted laser desorption ionization–time of flight mass spectrometry, molecular, or sequencing modalities. Table 2 provides taxonomic revisions for organisms originally recovered from nondomestic wildlife animal sources.

Novel taxa. Multiple new taxa have been accepted within the families *Streptococcaceae* and *Staphylococcaceae*. With respect to the *Streptococcaceae*, the majority of new additions were associated with disease in their host animal species. For example, *Lactococcus petauri* sp. nov. (18) was isolated from a facial abscess in a sugar glider (*Petaurus breviceps*). Sugar gliders are small arboreal marsupials indigenous to Australia and New Guinea that are frequently kept as pets. Although they are omnivorous, sugar gliders have a specialized dental structure that allows them to peel bark from trees to allow them access to tree sap or gum. As a result of their unique feeding behaviors, they are prone to diseases of the oral cavity and facial abscesses caused by trauma. Based on 16S rRNA gene sequencing and single nucleotide polymorphism analyses, *Lactococcus petauri* sp. nov. was determined to be most closely related to *Lactococcus garvieae* (18). *L. garvieae* was first isolated from a cow with mastitis and was granted the taxon *Streptococcus garvieae* (19). It is also a common fish pathogen that has been associated with gastrointestinal disorders and infective endocarditis in humans and has been described as an emerging zoonotic pathogen (20–23). Biochemically, *L. petauri* sp. nov. can be differentiated from *L. garvieae* based on the ability of *L. petauri* sp. nov. to produce acid from sucrose and D-tagatose (18). Interestingly, *L. petauri* is also now understood to be a significant pathogen of aquatic animals (24).

Four additional members of the *Streptococcaceae*, *Streptococcus respiraculi* sp. nov., *Streptococcus catagoni* sp. nov., *Streptococcus pacificus* sp. nov., and *Streptococcus zalophi* sp. nov., were isolated from the respiratory tracts of their host species (25–27). These species cause infections in locations similar to those of other members of the genus, namely, the lungs and tonsils, with potential migration to the brain in severe cases. *S. respiraculi* sp. nov. (25) was isolated from the respiratory tract of a Himalayan marmot (*Marmota himalayana*). The Himalayan marmot is an important reservoir of *Yersinia pestis*, and cases of human plague have been associated with the disruption of the habitat of Himalayan marmots as well as the skinning and eating of these animals (28, 29). Also identified from the Himalayan marmot were three novel Gram-positive bacilli, *Actinomyces marmotae* sp. nov. (30), *Corynebacterium lizhenjunii* sp. nov. (31),

TABLE 1 Novel bacterial species recovered from nondomestic wildlife veterinary material reported from January 2018 through December 2021

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
Gram-positive cocci				
Lactococcus petauri sp. nov.	*Streptococcaceae*	Sugar glider abscess	Facultative, catalase-negative, oxidase-negative, Gram-positive coccus; orange-pigmented, beta-hemolytic colonies on tryptic soy agar with 5% sheep blood; optimal growth at 20°C–40°C; D-ribose, amygdalin, sucrose, D-tagatose, and leucine arylamidase positive; D-xylose, lactose, melibiose, raffinose, and β-glucuronidase negative	18
Kocuria uropygioeca sp. nov.	*Micrococcaceae*	Preen gland of great spotted woodpecker (*Dendrocopos major*) from Germany	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive coccus; 1- to 2-mm-diam nonviscous, convex, circular, pale-orange-pigmented, gamma-hemolytic colonies on Columbia agar supplemented with sheep blood; optimal growth at 35°C; α-glucosidase, gelatin hydrolysis, and maltose positive; acid phosphatase, esculin hydrolysis, and nitrate reduction negative	69[a]
Kocuria uropygialis sp. nov.	*Micrococcaceae*	Preen gland of great spotted woodpecker (*Dendrocopos major*) from Germany	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive coccus; 1- to 2-mm-diam nonviscous, convex, circular, pale-orange-pigmented, gamma-hemolytic colonies on Columbia agar supplemented with sheep blood; optimal growth at 35°C; acid phosphatase, gelatin hydrolysis, and maltose positive; α-glucosidase, esculin hydrolysis, and nitrate reduction negative	69[a]
Streptococcus respiraculi sp. nov.	*Streptococcaceae*	Respiratory tract of Himalayan marmot (*Marmota himalayana*) from Tibet-Qinghai Plateau, China	Facultative, nonmotile, catalase-negative, non-spore-forming, Gram-positive coccus; 0.5- to 1-mm-diam nontranslucent, nonpigmented, alpha-hemolytic colonies on Columbia blood agar; growth range at 22°C–42°C; does not react with Lancefield A, B, C, D, F, or G antisera; growth in up to 2.5% NaCl; inulin and D-sorbitol positive; β-glucosidase and gentiobiose negative	25
Brachybacterium avium sp. nov.	*Dermabacteraceae*	Fecal sample from Andean condor (*Vultur gryphus*) from South Korea	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive coccus; 0.5- to 1-mm-diam ivory-colored, low-convex, circular colonies on tryptic soy agar; optimal growth at 30°C; glucose, arabinose, maltose, L-arabinose, D-adonitol, D-trehalose, and D-arabitol positive; dulcitol, β-glucuronidase, and urease negative; possesses β-lactamase; possesses a genetic determinant encoding a vancomycin B-type resistance protein	70[b]
Brachybacterium vulturis sp. nov.	*Dermabacteraceae*	Fecal sample from an Andean condor (*Vultur gryphus*) from South Korea	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive coccus; 0.5- to 1-mm-diam ivory-colored, low-convex, circular colonies on tryptic soy agar; optimal growth at 30°C; dulcitol, β-glucuronidase, and urease positive; glucose, arabinose, maltose, L-arabinose, D-adonitol, D-trehalose and D-arabitol negative; possesses β-lactamase	70[b]

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[a]	Reference(s)
Kocuria tytonis sp. nov.	*Micrococcaceae*	Preen gland of American barn owl (*Tyto furcata*) from Germany	Facultative, nonmotile, catalase-positive, non-spore-forming, Gram-positive coccus; 1- to 2-mm-diam orange, convex, opaque colonies on Columbia agar supplemented with 5% sheep blood; optimal growth at 30°C; esterase, esterase lipase, and gelatin hydrolysis positive; assimilates mannitol and malate; β-galactosidase, α-glucosidase, and urease negative; decreased MIC values for amoxicillin, doxycycline, erythromycin, and vancomycin; elevated MIC for polymyxin B	71
Streptococcus chenjunshii sp. nov.	*Streptococcaceae*	Tibetan antelope (*Pantholops hodgsonii*) feces from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive coccus; 0.5- to 1.3-mm-diam gray, opaque, rough-surfaced, alpha-hemolytic colonies on brain heart infusion agar; growth range at 25°C–39°C in brain heart infusion broth; inulin, raffinose, potassium, and 5-keto-glutarate positive; glycerol, D-tagatose, acid phosphatase, urea, and β-glucosidase negative	72
Vagococcus xieshaowenii sp. nov.	*Enterococcaceae*	Cloacal content of snow finch (*Montifringilla taczanowskii*) from Tibet-Qinghai Plateau, China	Aerobic, nonmotile, catalase-negative, oxidase-negative, Gram-positive coccus; 0.1- to 0.2-mm-diam pale white, smooth, circular, alpha-hemolytic colonies on brain heart infusion agar with 5% defibrinated sheep blood; optimal growth at 37°C; C_4 esterase, pyroglutamic acid arylamidase, D-mannitol, and D-ribose positive; leucine arylamidase, *N*-acetyl-β-glucosaminidase, lactose, trehalose, and sucrose negative; reported susceptibility to β-lactam agents, ciprofloxacin, tetracycline, and vancomycin; reported resistance to macrolides, clindamycin, and metronidazole	73
Jeotgalibaca ciconiae sp. nov.	*Carnobacteriaceae*	Feces of Oriental stork (*Ciconia boyciana*) from South Korea	Facultative, motile, catalase-negative, oxidase-negative, Gram-positive coccus; opaque, pale yellow, circular colonies on tryptic soy agar; optimal growth at 30°C; gentiobiose, *N*-acetyl-D-galactosamine, D-glucose-6-phosphate, D-fructose-6-phosphate, stachyose, raffinose, and β-glucuronidase positive; ribose, α-galactosidase, glycerol, gluconate, and arabinose negative	74
Arthrobacter yangruifuii sp. nov.	*Micrococcaceae*	Plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive coccus; 0.9- to 1.2-mm-diam yellow, round, convex colonies on brain heart infusion agar supplemented with 5% defibrinated sheep blood; growth range at 4°C–37°C; D-xylose and β-glucosidase positive; cellobiose and β-galactosidase negative	75
Arthrobacter zhaoguopingii sp. nov.	*Micrococcaceae*	Ruddy shelduck (*Tadorna ferruginea*) feces from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive coccus; 0.8- to 1-mm-diam rose/pink, circular, convex colonies on brain heart infusion agar with 5% defibrinated sheep blood; growth range at 4°C–30°C; cystine arylamidase positive; D-xylose and β-glucosidase negative	75

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
Streptococcus catagoni sp. nov.	*Streptococcaceae*	Lung of Chacoan peccary (*Catagonus wagneri*) with purulent pneumonia	Facultative, nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive coccus; 0.4- to 0.8-mm-diam beta-hemolytic colonies on blood agar cultivated at 37°C; glycogen and Voges-Proskauer test positive; β-glucosidase, α-galactosidase, pyrrolidonyl arylamidase, D-mannitol, and raffinose negative	26
Staphylococcus durrellii sp. nov.	*Staphylococcaceae*	Oropharynx of captive Livingstone's fruit bat (*Pteropus livingstonii*) from the United Kingdom	Catalase-positive, oxidase-negative, clumping factor-negative, coagulase-negative, nonhemolytic, Gram-positive coccus; 1- to 2-mm-diam smooth, shiny, domed, yellow colonies on Columbia agar with 5% sheep blood; isolate cultivated in a 37°C aerobic environment; β-glucuronidase, alkaline phosphatase, trehalose, and D-mannitol positive; acetoin, maltose, DNase, urease, and ornithine decarboxylase negative; resistant to novobiocin and susceptible to polymyxin B	35
Staphylococcus lloydii sp. nov.	*Staphylococcaceae*	Skin of captive Livingstone's fruit bat (*Pteropus livingstonii*) from the United Kingdom	Catalase-positive, oxidase-negative, clumping factor-negative, coagulase-negative, nonhemolytic, Gram-positive coccus; 1- to 2-mm-diam smooth, shiny, domed, white or yellow/cream colonies on Columbia agar with 5% sheep blood; isolate cultivated in a 37°C aerobic environment; acetoin and maltose positive; β-glucuronidase, DNase, urease, and ornithine decarboxylase negative; resistant to novobiocin and susceptible to polymyxin B	35
Streptococcus pacificus sp. nov.	*Streptococcaceae*	Lung tissue of California sea lion (*Zalophus californianus*) from the United States with acute domoic acid toxicity	Facultative, nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive coccus; $\leq$1-mm-diam gray, translucent, incomplete alpha-hemolytic colonies on blood agar; growth at 37°C; does not react with Lancefield A, B, C, D, F, or G antisera; Voges-Proskauer test and esculin hydrolysis positive; hippurate, H_2S, and nitrite reduction negative	27
Streptococcus zalophi sp. nov.	*Streptococcaceae*	Lung tissue of California sea lion (*Zalophus californianus*) from the United States with chronic domoic acid toxicity	Facultative, nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive coccus; $\leq$1-mm-diam gray, translucent, incomplete alpha-hemolytic colonies on blood agar; growth at 37°C; does not react with Lancefield A, B, C, D, F, or G antisera; hippurate and Voges-Proskauer test positive; H_2S and nitrate reduction negative	27
Gram-positive bacilli				
Virgibacillus phasianinus sp. nov.	*Bacillaceae*	Feces of Swinhoe's pheasant (*Lophura swinhoii*) from South Korea	Aerobic, motile, catalase-positive, Gram-positive bacillus; 0.5- to 1-mm-diam beige, convex, circular colonies on marine agar; optimal growth at 30°C; acid phosphatase positive; produces acid from glycerol, D-galactose, D-glucose, D-mannose, D-mannitol, maltose, sucrose, L-fucose, and D-arabitol; assimilates D-mannose, D-mannitol, *N*-acetylglucosamine, maltose, and potassium gluconate;	76

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			urease, β-glucuronidase, and D-xylose negative	
Tumebacillus avium sp. nov.	*Alicyclobacillaceae*	Gut of cinereous vulture (*Aegypius monachus*) from South Korea	Facultative, motile, catalase-negative, oxidase-negative, spore-forming, Gram-positive bacillus; circular, smooth, white colonies on Reasoner's 2A agar; optimal growth at 25°C–30°C; ribose and *N*-acetylglucosamine positive; nitrate reduction, DNase, and *N*-acetyl-β-glucosaminidase negative	77
Actinomyces tangfeifanii sp. nov.	*Actinomycetaceae*	Rectal swab from wild vulture (*Aegypius monachus*) from Tibet-Qinghai Plateau, China; taxon has been subject to subsequent revision to the novel genus *Boudabousia* (Table 2)	Facultative, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; 0.6- to 1-mm-diam gray/white, opaque, shiny colonies on sheep blood agar; cultivated at 37°C; produces acid from D-xylose and D-galactose; positive for nitrate reduction, gelatin hydrolysis, and α-fucosidase; negative for melibiose, sucrose, trehalose, melezitose, raffinose, D-mannose, L-sorbose, starch, and α-glucosidase	78
Nocardioides houyundeii sp. nov.	*Nocardioidaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, catalase-positive, oxidase-negative, nonmotile, Gram-positive bacillus; cream-colored, convex, circular colonies on brain heart infusion agar with 5% sheep agar; optimal growth at 28°C; positive reactions for α-glucosidase and D-tagatose; negative reactions for trypsin, D-arabitol, and D-mannitol	79
Cohnella faecalis sp. nov.	*Paenibacillaceae*	Animal feces collected from a karst cave in China	Aerobic, motile, catalase-positive, oxidase-positive, spore-forming, Gram-positive bacillus; white, convex, smooth colonies on Reasoner's 2A agar; optimal growth at 30°C; positive reaction for potassium gluconate; negative reactions for D-mannose, D-mannitol, *N*-acetyl-gluconate, and α-galactosidase	80
Salinibacterium hongtaonis sp. nov.	*Microbacteriaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, non-spore-forming, Gram-positive bacillus; pale yellow, opaque, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 28°C; positive reactions for L-arabinose, α-galactosidase, and β-glucosidase; negative reactions for D-mannose, starch, naphthol-AS-BI-phosphohydrolase, and β-galactosidase	81
Mycetocola zhujimingii sp. nov.	*Microbacteriaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, catalase-positive, non-spore-forming, Gram-positive bacillus; yellow, opaque, shiny, thick colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for D-tagatose, cystine arylamidase, and α-mannosidase; negative reactions for D-glucose, maltose, D-gentiobiose, and α-glucosidase	82
Paraliobacillus zengyii sp. nov.	*Bacillaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Facultative, motile, catalase-positive, oxidase-negative, spore-forming, Gram-positive bacillus; 1-mm-diam creamy white to pale yellow, convex, round colonies on brain heart infusion agar with 3% NaCl; optimal growth at 28°C; positive reactions for melibiose, D-mannitol, and D-xylose; negative reactions for leucine arylamidase, α-glucosidase, raffinose, sucrose, turanose, and melezitose	83

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[a]	Reference(s)
Filibacter tadaridae sp. nov.	*Caryophanaceae*	Isolated from guano of Mexican free-tailed bats (*Tadarida brasiliensis*) from the United States	Aerobic, nonmotile, oxidase-positive, non-spore-forming, Gram-positive bacillus; 2- to 3-mm-diam beige, convex, circular colonies on tryptic soy agar; optimal growth at 25°C–28°C; negative reactions for urease, D-glucose, and β-galactosidase	84
Fudania jinshanensis gen. nov., sp. nov.	*Actinomycetaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Facultative, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; $<$1-mm-diam white, opaque, convex, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 37°C; positive reactions for D-galactose, starch, and glycogen; negative reaction for trehalose	85
Actinomyces lilanjuaniae sp. nov.	*Actinomycetaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; white, dry, opaque, circular colonies on brain heart infusion agar; optimal growth at 37°C; positive reactions for D-adonitol and D-xylose; negative reactions for D-mannose, D-melibiose, and esterase	86
Nocardioides yefusunii sp. nov.	*Nocardioidaceae*	Feces of Tibetan wild ass (*Equus kiang*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam yellow, convex, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 28°C; positive reactions for β-glucosidase, D-fructose, and D-ribose; negative reactions for cellobiose, trehalose, and α-glucosidase	87
Actinomyces qiguomingii sp. nov.	*Actinomycetaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1-mm-diam white, convex, circular colonies on brain heart infusion-sheep blood agar; optimal growth at 37°C; positive reactions for D-mannitol, inulin, and alkaline phosphatase; negative reactions for D-arabitol and C_4 esterase	88
Microbacterium wangchenii sp. nov.	*Microbacteriaceae*	Fecal sample from Tibetan gazelle (*Procapra picticaudata*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; yellowish, convex, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 30°C; positive reactions for nitrate reduction, α-mannosidase, D-arabinose, and D-lyxose; negative reaction for β-galactosidase	89
Psychrobacillus vulpis sp. nov.	*Caryophanaceae*	Feces of red fox (*Vulpes vulpes*) from Spain	Facultative, motile, catalase-positive, oxidase-positive, spore-forming, Gram-positive bacillus; gray, transparent, vortex colonies on tryptic soy agar; optimal growth at 28°C; positive reactions for L-tyrosine, *N*-acetylglucosamine, and adipic acid; negative reactions for gelatin hydrolysis, urea hydrolysis, and starch	90
Weissella muntiaci sp. nov.	*Leuconostocaceae*	Feces of Formosan barking deer (*Muntiacus reevesi*) from Taiwan	Facultative, nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, flat, circular colonies on MRS agar; optimal growth at 30°C; positive reactions for L-arabinose and	91

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			acetoin production; negative reactions for D-fructose, D-mannose, maltose, and esculin hydrolysis	
Cellulomonas shaoxiangyii sp. nov.	*Cellulomonadaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; 0.5- to 1.1-mm-diam yellow, moist, circular colonies on Reasoner's 2A agar; optimal growth at 28°C; positive reactions for L-rhamnose, urea, and Voges-Proskauer tests; negative reactions for raffinose, D-mannitol, and gelatinase	92
Mumia zhuanghuii sp. nov.	*Nocardioidaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 0.2- to 0.5-mm-diam white, opaque, dry colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for D-arabinose, methyl-α-D-glucopyranoside, arbutin, and D-lyxose; negative reactions for D-ribose, D-galactose, D-fucose, and L-fucose	93
Agromyces badenianii sp. nov.	*Microbacteriaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, Gram-positive bacillus; yellow, convex, circular colonies on tryptic soy agar; optimal growth at 28°C; negative reactions for D-fructose, arbutin, salicin, starch, and leucine arylamidase	94
Georgenia wutianyii sp. nov.	*Bogoriellaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; 0.8- to 1.1-mm-diam yellow, opaque, circular colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for L-xylose, acid phosphatase, and arbutin; negative reactions for D-ribose, alkaline phosphatase, and α-glucosidase	95
Georgenia yuyongxinii sp. nov.	*Bogoriellaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; 0.6- to 1-mm-diam yellow, opaque, circular colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for D-ribose, alkaline phosphatase, and α-glucosidase; negative reactions for arbutin, D-galactose, gentiobiose, and acid phosphatase	95
Corynebacterium silvaticum sp. nov.	*Corynebacteriaceae*	Gross lesions caused by lamellar lymph node abscesses of wild boar and roe deer from Germany	Aerobic, microaerophilic, motile, catalase-variable, non-spore-forming, Gram-positive bacillus; white, waxy, small colonies on sheep blood agar; optimal growth at 37°C; positive reactions for urea, glucose, ribose, and maltose; negative reactions for glycogen, esculin, gelatin, mannitol, and sucrose	36
Nocardioides jishulii sp. nov.	*Nocardioidaceae*	Feces of Tibetan gazelle (*Procapra picticaudata*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; yellowish, convex, opaque colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 28°C; positive reactions for acid phosphatase, cellobiose, and D-fructose; negative reactions for D-ribose, melibiose, and mannitol	96
Actinomyces wuliandei sp. nov.	*Actinomycetaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Nonmotile Gram-positive bacillus; white, smooth, moist colonies on brain heart infusion-sheep blood agar; optimal growth at 37°C; positive reactions for	97

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			D-xylose, melezitose, glycogen, starch, and C_4 esterase; negative reactions for valine arylamidase, α-galactosidase, and β-galactosidase	
Corynebacterium liangguodongii sp. nov.	*Corynebacteriaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, non-spore-forming, Gram-positive bacillus; 0.8- to 1.5-mm-diam white, opaque, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 37°C; positive reactions for D-fructose, 5-potassium ketogluconate, and α-chymotrypsin; negative reactions for lactose, D-tagatose, and nitrate reduction	97
Corynebacterium yudongzhengii sp. nov.	*Corynebacteriaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, non-spore-forming, Gram-positive bacillus; 0.1- to 0.5-mm-diam yellow, dry, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 37°C; positive reactions for esculin, ribose, 5-potassium ketogluconate, and α-chymotrypsin; negative reactions for lactose and nitrate reduction	97
Oceanobacillus zhaokaii sp. nov.	*Bacillaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, motile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 1.8-mm-diam white, convex, circular colonies on marine agar; optimal growth at 35°C; positive reactions for amygdalin, glycerol, L-arabinose, and alkaline phosphatase; negative reactions for D-xylose, melibiose, raffinose, and acid phosphatase	97
Aeromicrobium chenweiae sp. nov.	*Nocardioidaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; white, convex, circular colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for *N*-acetylglucosamine, mannitol, α-fucosidase, and α-mannosidase; negative reactions for glycerol, maltose, and β-glucosidase	98
Aeromicrobium yanjiei sp. nov.	*Nocardioidaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; white, convex, circular colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for D-glucose, maltose, and β-glucosidase; negative reactions for inositol, L-arabinose, acid phosphatase, and cysteine arylamidase	98
Gulosibacter macacae sp. nov.	*Microbacteriaceae*	Feces of *Macaca mulatta* from China	Aerobic, nonmotile, catalase-positive, oxidase-positive, non-spore-forming, Gram-positive bacillus; 0.5- to 0.8-mm-diam white, convex, circular colonies on tryptic soy agar; optimal growth at 30°C–37°C; positive reactions for D-fructose, D-mannitol, trypsin, and β-glucuronidase; negative reactions for inositol, trehalose, salicin, and C_4 esterase	99
Flaviflexus ciconiae sp. nov.	*Actinomycetaceae*	Feces of Oriental stork (*Ciconia boyciana*) from South Korea	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; beige, raised, circular colonies on tryptic soy agar; optimal growth at 30°C–37°C; L-xylose, inositol, methyl-β-D-glucoside, *N*-acetyl-neuraminic acid, inosine,	100

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			D-arabitol, *myo*-inositol, D-gluconic acid, Tween 40, L-xylose, inositol, and β-galactosidase positive; L-malic acid, leucine arylamidase, D-xylose, and raffinose negative	
Corynebacterium anserum sp. nov.	*Corynebacteriaceae*	Feces of white-fronted goose (*Anser albifrons*) from China	Facultative, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam creamy/white, convex, circular colonies on tryptic soy agar; optimal growth at 35°C–37°C; acid phosphatase, galactose, and glucose positive; urease, cellobiose, trehalose, and ribose negative; reported susceptibility to penicillin, erythromycin, vancomycin, ciprofloxacin, tetracycline, and gentamicin	101
Microbacterium caowuchunii sp. nov.	*Microbacteriaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; 1.2- to 2.6-mm-diam ivory, opaque, circular colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for D-arabitol, erythritol, and C_8 esterase lipase; negative reactions for salicin, amygdalin, and melezitose	102
Microbacterium lushaniae sp. nov.	*Microbacteriaceae*	Intestinal contents of plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; 0.3- to 0.6-mm-diam white, opaque, dry colonies on brain heart infusion agar; optimal growth at 28°C; positive reactions for D-arabitol, erythritol, and C_8 esterase lipase; negative reactions for salicin, amygdalin, and melezitose	102
Actinomyces marmotae sp. nov.	*Actinomycetaceae*	Respiratory tract of Himalayan marmot (*Marmota himalayana*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; white, opaque, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 35°C; positive reactions for D-ribose, D-xylose, and arginine arylamidase; negative reactions for lactose, D-mannitol, inulin, and β-glucuronidase	30
Actinomyces procaprae sp. nov.	*Actinomycetaceae*	Feces of Tibetan gazelle (*Procapra picticaudata*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; white, opaque, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 37°C; positive reactions for lactose, melezitose, and α-galactosidase; negative reactions for D-ribose, arginine arylamidase, and β-glucosidase	30
Corynebacterium lizhenjunii sp. nov.	*Corynebacteriaceae*	Respiratory tract of Himalayan marmot (*Marmota himalayana*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam pale yellow, convex, opaque colonies on brain heart infusion agar; optimal growth at 37°C; positive reactions for esculin, D-fructose, and sucrose; negative reactions for alkaline phosphatase, D-galactose, and maltose	31
Corynebacterium qintianiae sp. nov.	*Corynebacteriaceae*	Lung tissue of blue sheep (*Pseudois nayaur*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam bright yellow, convex, circular colonies on brain heart infusion agar; optimal growth at 37°C; positive	31

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[a]	Reference(s)
			reactions for alkaline phosphatase, D-mannose, D-glucose, and D-fructose; negative reactions for esculin and D-mannitol	
Microbacterium chengjingii sp. nov.	*Microbacteriaceae*	Feces of bats (*Hipposideros* spp.) from China	Aerobic, nonmotile, catalase-positive, oxidase-negative, Gram-positive bacillus; white, round, moist, convex colonies on brain heart infusion agar; optimal growth at 28°C; α-mannosidase, β-glucosidase, D-adonitol, and D-ribose positive; α-galactosidase and methyl-β-D-xylopyranoside negative	103
Microbacterium fandaimingii sp. nov.	*Microbacteriaceae*	Feces of bats (*Rousettus* spp.) from China	Aerobic, motile, catalase-positive, oxidase-negative, Gram-positive bacillus; white, round, moist, convex colonies on brain heart infusion agar; optimal growth at 28°C; α-galactosidase and methyl-β-D-xylopyranoside positive; α-mannosidase, β-glucosidase, D-adonitol, and D-ribose negative	103
Gordonia jinghuaiqii sp. nov.	*Gordoniaceae*	Rectum of Himalayan marmot (*Marmot himalayana*) from Qinghai-Tibet Plateau, China	Facultative, catalase-positive, oxidase-negative, Gram-positive bacillus; beige, convex, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 35°C; positive reactions for ribose, glucose, esculin, and urease; negative reactions for galactose, maltose, citrate, and alkaline phosphatase	104
Gordonia zhaorongruii sp. nov.	*Gordoniaceae*	Feces of wild ass (*Equus kiang*) from Qinghai-Tibet Plateau, China	Aerobic, catalase-positive, oxidase-negative, Gram-positive bacillus; 1- to 2-mm-diam creamy, convex, round colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 28°C; positive reactions for glucose, fructose, maltose, and alkaline phosphatase; negative reactions for urease, galactose, and maltose	104
Nocardioides dongkuii sp. nov.	*Nocardioidaceae*	Feces of Tibetan antelope (*Pantholops hodgsonii*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; cream-colored, convex, circular colonies on brain heart infusion agar with 5% sheep blood; optimal growth at 28°C; positive reactions for D-galactose, D-xylose, and L-arabinose; negative reactions for alkaline phosphatase and C_{14} lipase	105
Ruania zhangjianzhongii sp. nov.	*Ruaniaceae*	Feces of bats (*Hipposideros* spp.) from China	Aerobic, nonmotile, catalase-positive, oxidase-positive, Gram-positive bacillus; circular, opaque, oyster white, convex colonies on sheep blood agar; optimal growth at 25°C; α-galactosidase, β-glucuronidase, leucine arylamidase, melibiose, and trehalose positive; nitrate reduction, citrate, acid phosphatase, β-glucosidase, and methyl-β-D-xylopyranoside negative	106
Corynebacterium zhongnanshanii sp. nov.	*Corynebacteriaceae*	Trachea of Himalayan marmot (*Marmot himalayana*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam gray, convex, circular colonies on brain heart infusion agar with 5% defibrinated sheep blood; optimal growth at 35°C–37°C; positive reactions for C_8 esterase lipase, urease, D-glucose, and ribose; negative	32

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			reactions for leucine arylamidase, cellobiose, galactose, and lactose	
Corynebacterium heidelbergense sp. nov.	*Corynebacteriaceae*	Preen glands of Egyptian goose (*Alopochen aegyptiacus*) from Germany	Facultative, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 0.5-mm-diam circular, nonpigmented, nonviscous, convex colonies on Columbia blood agar when cultivated at 37°C; positive for pyrazinamidase, urease, lipophilism, and acid from glucose; negative for pyrrolidonyl arylamidase and acid from ribose; MIC of ≤1 μg/mL reported for ampicillin, amikacin, ciprofloxacin, doxycycline, erythromycin, and vancomycin; polymyxin B MIC of >64 μg/mL	107[c]
Gram-negative diplococci				
Neisseria zalophi sp. nov.	*Neisseriaceae*	Oral cavity of California sea lion (*Zalophus californianus*)	Aerobic, nonmotile, catalase-positive, oxidase-positive, non-spore-forming, Gram-negative diplococcus and coccobacillus; 1- to 2-mm-diam circular, opaque, convex, gray-pigmented, nonhemolytic colonies cultivated on Columbia agar incubated at 36°C with 5% CO_2; no growth on MacConkey agar or modified Thayer-Martin agar; positive for nitrate reductase, proline arylamidase, C_8 esterase lipase, cystine acrylamidase, and acid phosphatase; negative for D-glucose and alkaline phosphatase	108[d]
Neisseria weixii sp. nov.	*Neisseriaceae*	Rectal contents of Tibetan Plateau pika (*Ochotona curzoniae*) from Qinghai-Tibet Plateau, China	Facultative, nonmotile, catalase-positive, oxidase-positive, non-spore-forming, Gram-negative diplococcus; 1.0- to 1.2-mm-diam raised, moist, ivory/white colonies on nutrient agar; growth at 22°C–42°C; no growth on MacConkey agar; nitrate reduction, alkaline phosphatase, leucine arylamidase, acid phosphatase, glucose, fructose, sucrose, proline arylamidase, and gluconate positive; C_8 esterase lipase, ornithine decarboxylase, erythritol, mannose, and xylitol negative	109
Roseomonas wenyumeiae sp. nov.	*Acetobacteraceae*	Tibetan antelope (*Pantholops hodgsonii*) feces from Qinghai-Tibet Plateau, China	Aerobic, motile, catalase-positive, oxidase-positive, non-spore-forming, Gram-negative coccus; 0.28- to 0.96-mm-diam pink, moist, opaque, circular, smooth colonies on Reasoner's 2A agar; optimal growth at 28°C–30°C; glycerol, D-galactose, D-glucose, D-mannitol, valeric acid, L-arabinose, and β-glucuronidase positive; adipic acid, alkaline phosphatase, C_4 esterase, C_8 esterase lipase, leucine arylamidase, acid phosphatase, and L-arginine negative	110
Gram-negative bacilli and coccobacilli				
Flavobacterium kingsejongi sp. nov.	*Flavobacteriaceae*	Feces of penguins from Antarctica	Aerobic, nonmotile, oxidase-positive, non-spore-forming, Gram-negative bacillus; yellow/orange, circular colonies on marine agar; optimal growth at 25°C; amygdalin, gelatin, starch, β-galactosidase, and tryptophan deaminase positive; nitrate reductase, L-arabinose, D-mannose, maltose, casein, and acid phosphatase negative	111

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[a]	Reference(s)
Oceanisphaera avium sp. nov.	*Aeromonadaceae*	Gut of cinereous vulture (*Aegypius monachus*) in South Korea	Aerobic, motile, oxidase-positive, Gram-negative bacillus; smooth, circular, beige colonies on modified tryptone-yeast extract-salt agar; optimal growth at 15°C–25°C; positive for C_4 esterase and D,L-lactic acid; negative for nitrate reduction, urease, alkaline phosphatase, valine arylamidase, and acid phosphatase; unable to assimilate glycogen, succinamic acid, L-proline, monomethyl ester, hydroxy-L-proline, D-serine, and α-ketoglutaric acid	112
Gorillibacterium massiliense gen. nov., sp. nov.	*Paenibacillaceae*	Feces of a gorilla from Cameroon	Facultative, nonmotile, oxidase-negative, non-spore-forming, Gram-negative bacillus; 0.5- to 1-mm-diam bright gray colonies on blood-enriched Columbia agar; optimal growth at 37°C; salicin, D-trehalose, D-melezitose, and glycogen positive; ribose, D-galactose, and amygdalin negative	113[e]
Enterobacter oligotrophica sp. nov.	*Enterobacteriaceae*	Initially recovered from leaf soil from Japan; recent report of isolation from a Caribbean lizard described in reference 114	Aerobic, motile, oxidase-negative, non-spore-forming, Gram-negative bacillus; 5-mm-diam light yellow, circular, smooth, glistening colonies on nutrient broth plates; optimal growth at 20°C; growth observed in nutrient-deficient medium; L-rhamnose, D-sorbitol, D-arabinose, L-fucose, D-lyxose, arginine dihydrolase, lysine decarboxylase, and ornithine decarboxylase positive; D-sucrose, D-melibiose, D-turanose, Voges-Proskauer test, inositol, and D-arabitol negative	115[f]
Iodobacter ciconiae sp. nov.	*Chromobacteriaceae*	Fecal sample from Oriental stork (*Ciconia boyciana*) collected from a zoo in South Korea	Facultative, nonmotile, oxidase-positive, Gram-negative bacillus; circular, beige, raised colonies on tryptic soy agar; optimal growth at 15°C; utilization of sucrose, acetoacetic acid, and L-lactic acid; *N*-acetylglucosamine, maltose, alkaline phosphatase, and valine arylamidase positive; D-mannose, D-fructose, L-histidine, D-arabinose, and arginine dihydrolase negative	116
Klebsiella africana sp. nov.	*Enterobacteriaceae*	Initial characterization from human isolate described in reference 117 and discussed previously in reference 118; recent report of isolation from Australian fruit bats (*Pteropus poliocephalus*) in reference 119	General characteristics analogous to those of *Klebsiella pneumoniae* (urease, Voges-Proskauer test, ONPG, and lysine decarboxylase positive; indole and ornithine decarboxylase negative); differentiated from other *K. pneumoniae* complex members by its inability to metabolize D-arabitol	117[g]
Rickettsia monacensis sp. nov.	*Rickettsiaceae*	Initially recovered in 2002 from *Ixodes ricinus* ticks in Europe; recent report of isolation from bats in reference 53	Intracellular propagation in cultures of mouse L-929, African green monkey Vero, *I. ricinus* IRE11, *Ixodes scapularis* ISE6, and *Dermacentor andersoni* DAE100 cells; organisms found free within the cytoplasm of host cells (occasionally within nuclei); ultrastructure similar to those of other rickettsiae (size range, 1–1.5 μm by 0.3–0.4 μm)	49[g]
Flavobacterium macacae sp. nov.	*Flavobacteriaceae*	Feces of primate (*Macaca mulatta*) from China	Aerobic, nonmotile, oxidase-positive, non-spore-forming, Gram-negative bacillus; yellow, viscous colonies on Luria-Bertani agar, nutrient agar, Reasoner's 2A agar, and tryptic soy agar; optimal growth at 28°C; arabinose, C_4 esterase, and C_8 esterase lipase positive; gelatin hydrolysis,	120

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			starch hydrolysis, amygdalin, gluconate, valine arylamidase, α-chymotrypsin, and adipate negative	
Psychrobacter pygoscelis sp. nov.	*Moraxellaceae*	Gentoo penguin chick (*Pygoscelis papua*) in Chilean Antarctica	Aerobic, nonmotile, catalase-positive, oxidase-positive, Gram-negative coccobacillus; white/beige, circular, shiny, smooth colonies on tryptic soy agar; optimal growth at 4°C–30°C; urease, dextrin, and lipase positive; Tween 80, D-glucosamine, 5-keto-D-gluconic acid, alkaline phosphatase, and cystine arylamidase negative	121
Pseudomonas leptonychotis sp. nov.	*Pseudomonadaceae*	Anal mucous membrane of seal (*Leptonychotes weddellii*) from Antarctica	Motile, oxidase-positive, Gram-negative bacillus; 2-mm-diam circular, yellow, irregular, smooth, shiny colonies on tryptic soy agar; optimal growth at 25°C; growth on MacConkey agar; beta-hemolysis not observed on blood agar; malonate, gelatin, casein, L-histidine, and D-serine positive; L-serine and DNase negative	122
Apibacter raozihei sp. nov.	*Weeksellaceae*	Feces of bats (*Hipposideros* spp. and *Taphozous* spp.) from China	Facultative, nonmotile, oxidase-negative, Gram-negative bacillus; 1- to 2-mm-diam shiny, convex, yellow colonies on sheep blood agar; optimal growth at 35°C; growth on MacConkey agar; β-galactosidase, *N*-acetyl-β-glucosaminidase, gentiobiose, and starch positive; negative for trypsin activity	123
Faecalibacter macacae gen. nov., sp. nov.	*Flavobacteriaceae*	Feces of monkey (*Macaca assamensis*) from China	Aerobic, nonmotile, oxidase-positive, Gram-negative bacillus; 1- to 8-mm-diam colonies on tryptic soy agar; optimal growth at 37°C–42°C; starch, Tween 80, urease, and nitrate reductase positive; D-glucose and indole negative; reported susceptibility to ceftriaxone, chloramphenicol, ciprofloxacin, clindamycin, erythromycin, gentamicin, penicillin, polymyxin B, and vancomycin; reported resistance to ampicillin	124
Paracoccus liaowanqingii sp. nov.	*Rhodobacteraceae*	Tibetan antelope (*Pantholops hodgsonii*) feces from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, non-spore-forming, Gram-negative bacillus; circular, orange, shiny, thin colonies on marine agar; optimal growth at 28°C; *N*-acetylglucosamine, C_{14} lipase, and β-glucuronidase positive; D-fucose, leucine arylamidase, and α-glucosidase negative	125
Bartonella kosoyi sp. nov.	*Bartonellaceae*	Blood of black rats (*Rattus rattus*) from Israel	Capnophilic, oxidase-negative, Gram-negative bacillus; 1- to 2-mm-diam smooth, circular colonies on chocolate agar; optimal growth at 37°C; arginine arylamidase and leucine arylamidase positive; proline, urease, and acetoin negative	40
Lysobacter pythonis sp. nov.	*Lysobacteraceae*	Respiratory tract of a python (*Python regius*) experiencing respiratory distress	Motile Gram-negative bacillus; yellow-pigmented colonies on peptone-yeast extract agar; growth also observed on 5% sheep blood agar and Sabouraud agar (weak growth); no growth on MacConkey agar; acetate, *trans*-aconitate, citrate, DL-lactate, oxoglutarate, and pyruvate positive; hydrolyzes pNP-phenyl-phosphonate and pNP-phosphoryl-choline; D-cellobiose, D-fructose, D-glucose, D-maltose, D-xylose, D-trehalose, D-ribose, fumarate, sucrose, salicin,	46[h]

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			L-aspartate, L-proline, and L-serine negative	
Oceanivirga miroungae sp. nov.	*Leptotrichiaceae*	Oral cavity of wild northern elephant seal (*Mirounga angustirostris*) from California	Facultative, nonmotile, oxidase-negative, catalase-negative, non-spore-forming, Gram-negative bacillus; capable of growth on PPLO, Columbia, brain heart infusion, and Wilkins-Chalgren anaerobic agars supplemented with 10–15% serum (1- to 3-mm-diam smooth, creamy colonies that slightly resemble a fried egg); optimal growth at 34°C–37°C; mild alpha-hemolysis when grown on media containing blood; no growth on MacConkey agar; arginine arylamidase, glycogen, sucrose, urease, leucine arylamidase, valine arylamidase, α-chymotrypsin, and α-glucosidase positive; L-pyrrolidonyl-arylamidase, phenylphosphonate, alkaline phosphatase, and acid phosphatase negative	126
Yersinia thracica sp. nov.	*Yersiniaceae*	Feces of wild boar (also isolated from pig, fish, and bird); archival isolate from reference laboratory in France	Facultative, oxidase-negative, Gram-negative bacillus; 50% of strains nonmotile when tested at 28°C; 2.5-mm-diam circular colonies with deep-red center surrounded by a pale transparent border on cefsulodin-irgasan-novobiocin agar at 28°C; urease, ornithine decarboxylase (75% of tested strains), and β-galactosidase (75% of tested strains) positive; citrate, arginine dihydrolase, lysine decarboxylase, tryptophan deaminase, indole, Voges Proskauer test, and gelatinase negative	127
Acinetobacter lanii sp. nov.	*Moraxellaceae*	Feces of Tibetan wild ass (*Equus kiang*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, oxidase-negative, Gram-negative coccobacillus; opaque, milky white, convex colonies on tryptic soy agar; optimal growth at 28°C; beta-hemolysis not observed on blood agar; β-alanine positive; citrate, L-arginine, L-glutamate, and gentisate negative	128
Acinetobacter shaoyimingii sp. nov.	*Moraxellaceae*	Feces of Tibetan wild ass (*Equus kiang*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, oxidase-negative, Gram-negative coccobacillus; opaque, milky white, convex colonies on tryptic soy agar; optimal growth at 28°C; beta-hemolysis not observed on blood agar; β-alanine and L-glutamate positive; citrate, L-arginine, and gentisate negative; respiratory quinone distribution of 7.0% Q-8, 88.0% C-9, 4.1% Q-10	128
Acinetobacter wanghuae sp. nov.	*Moraxellaceae*	Feces of Tibetan wild ass (*Equus kiang*) from Qinghai-Tibet Plateau, China	Aerobic, nonmotile, oxidase-negative, Gram-negative coccobacillus; opaque, milky white, convex colonies on tryptic soy agar; optimal growth at 28°C; beta-hemolysis not observed on blood agar; L-glutamate and β-alanine positive; citrate, L-arginine, and gentisate negative; respiratory quinone distribution of 3.6% Q-8, 89.3% Q-9, 7.0% Q-10	128
Jinshanibacter xujianqingii sp. nov.	*Budviciaceae*	Cloacal content of snow finch (*Montifringilla taczanowskii*); taxon now considered to be homotypic synonym (Table 2)	Facultative, motile, oxidase-negative, Gram-negative bacillus; small, circular, convex, cream-colored colonies on nutrient agar; optimal growth at 28°C; positive for acid phosphatase, esterase, leucine arylamidase, L-arabinose, and gentiobiose; negative for valine	129

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			arylamidase, D-fructose, D-mannitol, hydrogen sulfide, salicin, and inositol	
Jinshanibacter zhutongyuii sp. nov.	*Budviciaceae*	Cloacal content of snow finch (*Montifringilla taczanowskii*)	Facultative, motile, oxidase-negative, Gram-negative bacillus; small, circular, convex, cream-colored colonies on nutrient agar; optimal growth at 28°C; positive for acid phosphatase, esterase, leucine arylamidase, L-arabinose, gentiobiose, valine arylamidase, D-fructose, and D-mannitol; negative for hydrogen sulfide, salicin, and inositol	129
Pelistega ratti sp. nov.	*Alcaligenaceae*	Feces of rats (*Rattus norvegicus*) from China	Facultative, nonmotile, oxidase-positive, non-spore-forming, Gram-negative bacillus; 1-mm-diam convex, opaque, circular, milky white colonies on brain heart infusion-sheep blood agar; optimal growth at 37°C; gelatinase, C_8 esterase lipase, and tyrosine arylamidase positive; L-lactate, malic acid, and valine arylamidase negative	130
Spirabiliibacterium falconis comb. nov.	*Pasteurellaceae*	Bronchopneumonia in a kestrel	Phenotypic characteristics are largely consistent with those of other *Pasteurellaceae*; nonmotile, oxidase-negative, non-spore-forming, Gram-negative coccobacillus; does not require hemin for growth; pinpoint-sized to 1.5-mm-diam nonhemolytic colonies; growth may be enhanced by incubation on enhanced chocolate agar in 35°C CO_2; V-factor requirement, D-xylose, trehalose, α-glucosidase, and β-glucosidase positive; catalase, sucrose, and esculin negative	47
Spirabiliibacterium pneumoniae comb. nov.	*Pasteurellaceae*	Pneumonia in a pigeon hawk	Phenotypic characteristics are largely consistent with those of other *Pasteurellaceae*; nonmotile, oxidase-negative, non-spore-forming, Gram-negative coccobacillus; does not require hemin for growth; pinpoint-sized to 1.5-mm-diam nonhemolytic colonies; growth may be enhanced by incubation on enhanced chocolate agar in 35°C CO_2; catalase positive; D-xylose, sucrose, esculin, β-glucosidase, V-factor requirement, trehalose, and α-glucosidase negative; formerly classified as Bisgaard taxon 32	47
Faecalibacter rhinopitheci sp. nov.	*Flavobacteriaceae*	Feces of wild Yunnan snub-nosed monkey (*Rhinopithecus bieti*) from China	Facultative, nonmotile, oxidase-positive, Gram-negative bacillus; yellow colonies on tryptic soy agar; optimal growth at 28°C–35°C; D-glucose, α-galactosidase, β-glucosidase, α-mannosidase, and Tween 60 positive; cellulose and nitrate reduction negative	131
Luteolibacter ambystomatis sp. nov.	*Verrucomicrobiaceae*	Skin lesion of Anderson's salamander (*Ambystoma andersoni*) from Austria	Nonmotile, oxidase-negative, Gram-negative bacillus; optimal growth at 20°C–28°C under aerobic conditions; beta-hemolysis not observed on blood agar; leucine arylamidase, α-galactosidase, C_4 esterase, and C_8 esterase lipase positive; α-chymotrypsin, α-mannosidase, trypsin, α-glucosidase, and urease negative	132
Paralysiella testudinis gen. nov., sp. nov.	*Neisseriaceae*	Inflamed cloaca of zoo-kept toad-headed turtle (*Mesoclemmys nasuta*)	Aerobic, nonmotile, catalase-positive, oxidase-positive, Gram-negative bacillus; 5-mm-diam beige-pigmented, nonhemolytic colonies on 3.3×	133

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[g]	Reference(s)
			peptone-yeast extract agar; growth range at 20°C–37°C; no growth on MacConkey agar; D-arabinose, C_4 esterase, leucine arylamidase, cysteine arylamidase, α-galactosidase, and D-mannose positive; D-melezitose, maltose, D-glucose, D-sorbitol, sucrose, dulcitol, raffinose, lactose, alkaline phosphatase, acid phosphatase, β-glucosidase, esculin, gelatinase, urease, and citrate negative	
Gram-positive anaerobes				
Bifidobacterium callitrichidarum sp. nov.	*Bifidobacteriaceae*	Feces of emperor tamarin (*Sanguinus imperator*) from Italy	Anaerobic (can also grow under aerophilic and microaerophilic conditions), nonmotile, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth colonies on tryptone-yeast extract agar; optimal growth at 45°C; hydrolyzes esculin; α-glucosidase, β-glucosidase, α-arabinosidase, and arginine dihydrolase positive; D-ribose, alkaline phosphatase, leucyl glycine arylamidase, glycine arylamidase, and urease negative	134
Bifidobacterium vansinderenii sp. nov.	*Bifidobacteriaceae*	Feces of emperor tamarin (*Sanguinus imperator*)	Anaerobic (can also grow under aerobic conditions), nonmotile, non-spore-forming, Gram-positive bacillus; 1- to 2.5-mm-diam white, circular colonies on MRS agar; anaerobic growth range at 25°C–42°C; aerobic growth range at 35°C–42°C; strong fermentation of fructose, galactose, glucose, lactose, maltose, mannitol, melibiose, raffinose, and sucrose; weak fermentation of glycogen and xylose; arginine dihydrolase, α-glucosidase, and *N*-acetyl-β-glucosaminidase positive; β-glucuronidase, glutamic acid decarboxylase, pyroglutamic acid arylamidase, and serine arylamidase negative	135
Bifidobacterium catulorum sp. nov.	*Bifidobacteriaceae*	Feces of common marmoset (*Callithrix jacchus*)	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on tryptone-yeast extract agar; optimal growth at 37°C; D-ribose, D-sorbitol, turanose, D-arabitol, α-glucosidase, alkaline phosphatase, and arginine arylamidase positive; glycerol, D-galactose, D-mannose, L-rhamnose, salicin, cellobiose, raffinose, urease, L-arginine, and alanine arylamidase negative	136
Bifidobacterium aerophilum sp. nov.	*Bifidobacteriaceae*	Feces of cotton-top tamarin (*Saguinus oedipus* L.) from Italy	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 40°C; α-arabinosidase, *N*-acetyl-β-glucosaminidase, D-mannose, arbutin, D-maltose, and D-saccharose	137[i]

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			positive; L-xylose, gentiobiose, and arginine dihydrolase negative	
Bifidobacterium avesanii sp. nov.	*Bifidobacteriaceae*	Feces of cotton-top tamarin (*Saguinus oedipus* L.) from Italy	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1.5- to 2.5-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 40°C; D-saccharose and L-xylose positive; α-arabinosidase, *N*-acetyl-β-glucosaminidase, D-mannose, arbutin, D-maltose, D-ribose, β-glucosidase, gentiobiose, and arginine dihydrolase negative	137[j]
Bifidobacterium ramosum sp. nov.	*Bifidobacteriaceae*	Feces of cotton-top tamarin (*Saguinus oedipus* L.) from Italy	Anaerobic (can also grow under microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2.5-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 40°C; α-arabinosidase, D-ribose, gentiobiose, and arginine dihydrolase positive; *N*-acetyl-β-glucosaminidase, D-mannose, arbutin, D-maltose, β-glucosidase, D-saccharose, and L-xylose negative	137[i]
Bifidobacterium callimiconis sp. nov.	*Bifidobacteriaceae*	Feces of Goeldi's marmoset (*Callimico goeldii*)	Anaerobic (can also grow under aerobic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2.5-mm-diam white, circular colonies on MRS agar; optimal growth at 30°C–37°C; positive reactions for D-mannitol, D-arabinose, turanose, trehalose, D-sorbitol, and L-rhamnose; negative reaction for *N*-acetyl-D-galactosamine	138
Bifidobacterium castoris sp. nov.	*Bifidobacteriaceae*	Feces of European beaver (*Castor fiber*)	Anaerobic (can also grow under aerobic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2.5-mm-diam white, circular colonies on MRS agar; optimal growth at 30°C–37°C; positive reactions for *N*-acetyl-D-galactosamine and trehalose; negative reactions for D-fructose and D-arabinose	138
Bifidobacterium dolichotidis sp. nov.	*Bifidobacteriaceae*	Feces of Patagonian mara (*Dolichotis patagonum*)	Anaerobic (can also grow under aerobic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2.5-mm-diam white, circular colonies on MRS agar; optimal growth at 35°C–37°C; positive reactions for D-arabinose and D-xylose; negative reactions for *N*-acetyl-D-glucosamine, trehalose, and turanose	138
Bifidobacterium goeldii sp. nov.	*Bifidobacteriaceae*	Feces of Goeldi's marmoset (*Callimico goeldii*)	Anaerobic (can also grow under aerobic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2.5-mm-diam white, circular colonies on MRS agar; optimal growth at 30°C–37°C; positive reactions for D-fructose and D-glucose; negative reactions for maltodextrin, D-mannitol, and trehalose	138

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
Bifidobacterium samirii sp. nov.	*Bifidobacteriaceae*	Feces of black-capped squirrel monkey (*Saimiri boliviensis* subsp. *peruviensis*)	Anaerobic (can also grow under aerobic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, circular colonies on MRS agar; optimal growth at 35°C–40°C; positive reactions for D-fructose and raffinose; negative reactions for D-xylose, *N*-acetyl-D-glucosamine, turanose, and trehalose	138
Bifidobacterium jacchi sp. nov.	*Bifidobacteriaceae*	Feces of baby common marmoset (*Callithrix jacchus*)	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, circular colonies on tryptone-yeast extract agar; optimal growth at 37°C; positive reactions for *N*-acetyl-β-glucosaminidase, D-ribose, D-galactose, and arbutin; negative reactions for melezitose, esculin, and alanine arylamidase	139
Alloscardovia theropitheci sp. nov.	*Bifidobacteriaceae*	Feces of adult gelada baboon (*Theropithecus gelada*) from Italy	Anaerobic, nonmotile, catalase-positive, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam circular, white, opaque, smooth colonies on tryptone-yeast extract agar; optimal growth at 37°C; α-arabinosidase, α-fucosidase, α-mannosidase, leucyl glycine arylamidase, proline arylamidase, alanine arylamidase, glycine arylamidase, and arbutin positive; D-xylose, cellobiose, lactose, starch, glycogen, and turanose negative	140
Bifidobacterium primatium sp. nov.	*Bifidobacteriaceae*	Feces of cotton-top tamarin (*Saguinus oedipus*) from Italy	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 37°C; arginine arylamidase, leucyl glycine arylamidase, glycine arylamidase, D-galactose, D-sorbitol, arbutin, D-lactose, D-raffinose, glycogen, and D-arabitol positive; α-glucosidase, β-glucosidase, α-arabinosidase, D-adonitol, glutamyl glutamic acid, and amygdalin negative	141[h]
Bifidobacterium scaligerum sp. nov.	*Bifidobacteriaceae*	Feces of cotton-top tamarin (*Saguinus oedipus*) from Italy	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, nonhemolytic, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 37°C; α-arabinosidase, arginine arylamidase, leucyl glycine arylamidase, glycine arylamidase, α-glucosidase, β-glucosidase, D-galactose, amygdalin, D-lactose, D-raffinose, and glutamyl glutamic acid positive; D-sorbitol, arbutin, glycogen, D-adonitol, and D-arabitol negative	141[h]

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
Bifidobacterium felsineum sp. nov.	*Bifidobacteriaceae*	Feces of emperor tamarin (*Saguinus imperator*) from Italy	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, nonhemolytic, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 37°C; leucyl glycine arylamidase, α-glucosidase, β-glucosidase, D-adonitol, D-raffinose, and arbutin positive; α-arabinosidase, arginine arylamidase, glycine arylamidase, D-galactose, amygdalin, D-lactose, glutamyl glutamic acid, D-sorbitol, glycogen, and D-arabitol negative	141[h]
Bifidobacterium simiarum sp. nov.	*Bifidobacteriaceae*	Feces of emperor tamarin (*Saguinus imperator*) from Italy	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, Gram-positive bacillus; 1.5- to 2-mm-diam white, opaque, smooth, circular colonies on the surface of tryptone-yeast extract agar; embedded colonies are lens shaped or elliptical; optimal growth at 37°C; α-arabinosidase, arginine arylamidase, glycine arylamidase, α-glucosidase, β-glucosidase, D-galactose, amygdalin, D-lactose, and arbutin positive; leucyl glycine arylamidase, D-raffinose, glutamyl glutamic acid, D-sorbitol, glycogen, D-adonitol, and D-arabitol negative	141[h]
Bifidobacterium erythrocebi sp. nov.	*Bifidobacteriaceae*	Feces of patas monkey (*Erythrocebus patas*) from Czechia	Anaerobic, nonmotile, non-spore-forming, Gram-positive bacillus; 2- to 3-mm-diam white, circular (with a 2nd slimy layer) colonies on the surface of supplemented Wilkins-Chalgren medium; embedded colonies are white and elliptical; optimal growth at 37°C; amygdalin, melibiose, raffinose, D-ribose, D-sorbitol, turanose, gentiobiose, and glycogen positive; arbutin, D-mannitol, D-mannose, melezitose, D-xylose, and salicin negative	142
Bifidobacterium moraviense sp. nov.	*Bifidobacteriaceae*	Feces of Goeldi's marmoset (*Callimico goeldii*) from Czechia	Anaerobic (can also grow under microaerophilic conditions), nonmotile, non-spore-forming, Gram-positive bacillus; 2- to 3-mm-diam white, circular colonies on the surface of supplemented Wilkins-Chalgren medium; embedded colonies are white and elliptical; optimal growth at 37°C; D-xylose and L-arabinose positive; amygdalin, melibiose, raffinose, D-ribose, D-sorbitol, turanose, gentiobiose, glycogen, arbutin, D-mannitol, D-mannose, melezitose, D-xylose, and salicin negative	142
Bifidobacterium oedipodis sp. nov.	*Bifidobacteriaceae*	Feces of cotton-top tamarin (*Saguinus oedipus*) from Czechia	Anaerobic (can also grow under microaerophilic conditions), nonmotile, non-spore-forming, Gram-positive bacillus; 2- to 3-mm-diam white, circular colonies on the surface of supplemented Wilkins-Chalgren medium; embedded colonies are white	142

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			and elliptical; optimal growth at 37°C; D-mannitol, D-mannose, melezitose, melibiose, raffinose, D-ribose, turanose, D-xylose, L-arabinose, and salicin positive; arbutin, D-sorbitol, and gentiobiose negative	
Bifidobacterium olomucense sp. nov.	*Bifidobacteriaceae*	Feces of mustached tamarin (*Saguinus mystax*) from Czechia	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, non-spore-forming, Gram-positive bacillus; 1- to 2-mm-diam white, circular colonies on the surface of supplemented Wilkins-Chalgren medium; embedded colonies are white and elliptical; optimal growth at 37°C; amygdalin, arbutin, D-mannose, melezitose, melibiose, raffinose, D-xylose, gentiobiose, and salicin positive; D-mannitol, D-ribose, D-sorbitol, turanose, and glycogen negative	142
Bifidobacterium panos sp. nov.	*Bifidobacteriaceae*	Feces of chimpanzee (*Pan troglodytes*) from Czechia	Anaerobic (can also grow under microaerophilic conditions), nonmotile, non-spore-forming, Gram-positive bacillus; 1-mm-diam transparent white, slightly irregular colonies on supplemented Wilkins-Chalgren medium; optimal growth at 37°C; D-mannose, melibiose, raffinose, D-ribose, turanose, and D-xylose positive; amygdalin, arbutin, cellobiose, D-mannitol, melezitose, D-sorbitol, gentiobiose, and salicin negative	142
Bifidobacterium rousetti sp. nov.	*Bifidobacteriaceae*	Feces of Egyptian fruit bat (*Rousettus aegyptiacus*)	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, nonhemolytic, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on tryptone-yeast extract agar; optimal growth at 37°C; sorbitol, esculin, and glutamic acid decarboxylase positive; D-xylose, sucrose, *N*-acetyl-β-glucosaminidase, alkaline phosphatase, leucyl glycine arylamidase, and pyroglutamic acid arylamidase negative	143[k]
Bifidobacterium vespertilionis sp. nov.	*Bifidobacteriaceae*	Feces of Egyptian fruit bat (*Rousettus aegyptiacus*)	Anaerobic (can also grow under aerobic and microaerophilic conditions), nonmotile, catalase-negative, oxidase-negative, non-spore-forming, nonhemolytic, Gram-positive bacillus; 1- to 2-mm-diam white, opaque, smooth, circular colonies on tryptone-yeast extract agar; optimal growth at 37°C; D-xylose, sucrose, *N*-acetyl-β-glucosaminidase, alkaline phosphatase, leucyl glycine arylamidase, and pyroglutamic acid arylamidase positive; sorbitol, esculin, and glutamic acid decarboxylase negative	143[k]
Lactobacillus xujianguonis sp. nov.	*Lactobacillaceae*	Feces of Himalayan marmot (*Marmota himalayana*) from Qinghai-Tibet Plateau, China	Anaerobic (can also grow under microaerophilic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; white, irregular, circular colonies on MRS agar; optimal growth at 37°C–40°C; positive reactions for potassium-	144

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			5-ketogluconate, L-arabinose, and D-ribose; negative reactions for galactose, D-mannose, and trehalose	
Limosilactobacillus agrestis sp. nov.	*Lactobacillaceae*	Jejunum of field vole (*Microtus agrestis*) from Lithuania	Anaerobic, nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 2.2- to 5.2-mm-diam yellow, translucent, flat colonies on MRS agar; optimal growth at 37°C; positive reactions for L-arabinose and esculin; negative reactions for D-fructose, lactose, and glycerol	145
Limosilactobacillus balticus sp. nov.	*Lactobacillaceae*	Jejunum of yellow-necked mouse (*Apodemus flavicollis*) from Lithuania	Anaerobic, nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1.2- to 3.2-mm-diam white, opaque, circular colonies on MRS agar; optimal growth at 37°C; positive reactions for L-arabinose, esculin, and maltose; negative reactions for erythritol, glycerol, and D-arabinose	145
Limosilactobacillus fastidiosus sp. nov.	*Lactobacillaceae*	Jejunum of root vole (*Microtus oeconomus*) from Lithuania	Anaerobic, nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1.2- to 2.2-mm-diam whitish, opaque, circular colonies on MRS agar; optimal growth at 37°C; positive reactions for L-arabinose and esculin; negative reactions for dulcitol, inositol, trehalose, and inulin	145
Limosilactobacillus rudii sp. nov.	*Lactobacillaceae*	Feces of striped mouse (*Rhabdomys pumilio*) from the United States	Anaerobic (can also grow under aerobic conditions), nonmotile, catalase-negative, non-spore-forming, Gram-positive bacillus; 1- to 2.2-mm-diam whitish, opaque, circular colonies on MRS agar; optimal growth at 37°C; positive reactions for maltose, lactose, and sucrose; negative reactions for L-xylose, D-fructose, and starch	145
Lactobacillus nasalidis sp. nov.	*Lactobacillaceae*	Forestomach contents of a captive proboscis monkey (*Nasalis larvatus*) from Japan	Anaerobic (can also grow under aerobic conditions), nonmotile Gram-positive bacillus; 1- to 2-mm-diam white, convex, smooth colonies on MRS agar; optimal growth at 20°C–45°C; positive reactions for salicin, trehalose, and acid phosphatase; negative reactions for D-galactose, starch, and chymotrypsin	146
Nanchangia anserum gen. nov., sp. nov.	*Actinomycetaceae*	Feces of greater white-fronted goose (*Anser albifrons*) from China	Anaerobic, nonmotile, catalase-negative, oxidase-positive, non-spore-forming, Gram-positive bacillus; <1-mm-diam white, convex, opaque colonies on sheep blood agar; acid production from xylose, D-sorbitol, and trehalose; positive for α-galactosidase, β-galactosidase, and β-glucosidase; whole-cell sugars comprised of galactose, arabinose, and glucose	147
Clostridium chrysemydis sp. nov.	*Clostridiaceae*	Fecal material of painted turtle (*Chrysemys picta*) from the United States	Anaerobic, motile, rare-spore-forming, slender, Gram-positive bacillus; nonpigmented, beta-hemolytic colonies on tryptic soy agar with 5% sheep blood that grow under the surface of the medium; growth range at 25°C–45°C; lecithinase, alkaline phosphatase, arginine dihydrolase, β-galactosidase, α-glucosidase, β-glucuronidase, and nitrate reductase positive; indole, raffinose, urease, leucine arylamidase, α-fucosidase, and α-galactosidase negative	148
Gram-negative anaerobes				
Phascolarctobacterium wakonense sp. nov.	*Acidaminococcaceae*	Feces of common marmoset (*Callithrix jacchus*) from Japan	Anaerobic, nonmotile, non-spore-forming, Gram-negative bacillus;	149

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			1-mm-diam circular, smooth, transparent, nonhemolytic colonies cultivated on peptone-yeast extract agar supplemented with succinate at 37°C; susceptibility to ≤0.5% bile; alkaline phosphatase, acid phosphatase, and esterase positive; nitrate reduction, urease, arginine dihydrolase, esculin, α-galactosidase, β-galactosidase, α-glucosidase, and β-glucosidase negative; succinate (propionic acid as the major end product) and pyruvate (propionic acid and acetic acid as end products) utilized for growth	
Spirochetes and curved bacteria				
Campylobacter blaseri sp. nov.	*Campylobacteraceae*	Common seal (*Phoca vitulina*) from The Netherlands	Microaerophilic, nonmotile, oxidase-positive, catalase-positive, slightly curved, Gram-negative bacillus; 1- to 2-mm-diam raised, circular, smooth colonies on Columbia agar supplemented with 5% sheep blood; growth observed at 25°C, 37°C, and 42°C; urease, alkaline phosphatase, nitrate reduction, and indoxyl acetate positive; γ-glutamyl-transferase and hippurate negative; susceptible to cephalothin; most strains susceptible to nalidixic acid; growth slightly inhibited in the absence of hydrogen	150
Helicobacter labacensis sp. nov.	*Helicobacteraceae*	Gastric mucosa of red fox (*Vulpes vulpes*) from Slovenia	Microaerophilic, motile, oxidase-positive, catalase-positive, large helical, Gram-negative bacillus; capable of thin-film growth on fresh, moist blood agar and chocolate agar at 37°C (not at 25°C or 42°C); alkaline phosphatase, esterase, γ-glutamyl transpeptidase, nitrate reduction, and urease positive; indoxyl acetate and hippurate negative; susceptible to cephalothin and nalidixic acid	151
Helicobacter mehlei sp. nov.	*Helicobacteraceae*	Gastric mucosa of red fox (*Vulpes vulpes*) from Slovenia	Microaerophilic, motile, oxidase-positive, catalase-positive, large helical, Gram-negative bacillus; capable of thin-film growth on fresh, moist blood agar and chocolate agar at 37°C (not at 25°C or 42°C); esterase, γ-glutamyl transpeptidase, and urease positive; alkaline phosphatase, indoxyl acetate, nitrate reduction, and hippurate negative; susceptible to cephalothin and nalidixic acid	151
Helicobacter vulpis sp. nov.	*Helicobacteraceae*	Gastric mucosa of red fox (*Vulpes vulpes*) from Slovenia	Microaerophilic, motile, oxidase-positive, catalase-positive, large helical, Gram-negative bacillus; capable of thin-film growth on fresh, moist blood agar and chocolate agar at 37°C (not at 25°C or 42°C); esterase, γ-glutamyl transpeptidase, alkaline phosphatase, nitrate reduction, and urease positive; indoxyl acetate and hippurate negative; susceptible to cephalothin and nalidixic acid	151
Helicobacter enhydrae sp. nov.	*Helicobacteraceae*	Inflamed gastric tissue of southern sea otter from California; nonvalidly published as "*H. enhydrae* sp. nov." until 2020	Microaerophilic, motile, oxidase-positive, catalase-positive, slightly curved, Gram-negative bacillus; entire colonies observed on blood agar after 3–5 days of incubation at 37°C and 42°C (not at 25°C); growth in 1% glycine; γ-glutamyl	56[l]

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TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			transpeptidase, urease, indoxyl acetate, alkaline phosphatase, and nitrate reduction negative; resistant to cephalothin; susceptible to nalidixic acid	
Leptospira tipperaryensis sp. nov.	*Leptospiraceae*	Greater white-toothed shrew (*Crocidura russula*) from Ireland	No phenotypic characterization provided	152[m]
Campylobacter novaezeelandiae sp. nov.	*Campylobacteraceae*	Bird feces (3 starlings, 1 duck) from New Zealand	Microaerophilic, motile, oxidase-positive, Gram-negative, spiral bacillus; 0.5- to 1-mm-diam gray, smooth, entire colonies on Columbia agar with strong, dark alpha-hemolysis; growth at 37°C and 42°C but faster growth exhibited at 37°C; catalase, indoxyl acetate, and nitrate reduction positive; hippurate hydrolysis, alkaline phosphatase, hydrogen sulfide, and urease negative; resistant to cephalothin; susceptible to nalidixic acid	153
Campylobacter aviculae sp. nov.	*Campylobacteraceae*	Feces of laboratory-maintained zebra finch (*Taeniopygia guttata*) from the United States	Microaerophilic, motile, oxidase-positive, Gram-negative, slightly curved bacillus; growth at 37°C and 42°C but no growth at 25°C; variable growth in 1% glycine; hippurate hydrolysis positive; catalase, urease, indoxyl acetate, and γ-glutamyl transpeptidase negative; resistant to cephalothin; susceptible to nalidixic acid	154[n]
Campylobacter estrildidarum sp. nov.	*Campylobacteraceae*	Feces of laboratory-maintained zebra finch (*Taeniopygia guttata*) from the United States	Microaerophilic, motile, oxidase-positive, Gram-negative, slightly curved bacillus; growth at 37°C and 42°C but no growth at 25°C; variable growth in 1% glycine; variable catalase and hippurate hydrolysis activities; urease, indoxyl acetate, and γ-glutamyl transpeptidase negative; resistant to cephalothin; variable resistance to nalidixic acid	154[n]
Campylobacter taeniopygiae sp. nov.	*Campylobacteraceae*	Feces of laboratory-maintained zebra finch (*Taeniopygia guttata*) from the United States	Microaerophilic, motile, oxidase-positive, Gram-negative, slightly curved bacillus; growth at 37°C and 42°C but no growth at 25°C; no growth in 1% glycine; hippurate hydrolysis and catalase positive; urease, indoxyl acetate, and γ-glutamyl transpeptidase negative; resistant to cephalothin; variable resistance to nalidixic acid	154[n]
Helicobacter monodelphidis sp. nov.	*Helicobacteraceae*	Colon of opossum (*Monodelphis domestica*) with cloacal prolapse from the United States	Microaerophilic, motile, oxidase-positive, catalase-positive, slender, slightly curved, Gram-negative bacillus; capable of spreading-film growth on blood agar at 37°C (not at 25°C or 42°C); γ-glutamyl transpeptidase and alkaline phosphatase positive; urease and indoxyl acetate negative; resistant to cephalothin and nalidixic acid	57
Helicobacter didelphidarum sp. nov.	*Helicobacteraceae*	Feces of opossum (*Monodelphis domestica*) with cloacal prolapse from the United States	Microaerophilic, motile, oxidase-positive, catalase-positive, fusiform, Gram-negative bacillus; capable of spreading-film growth on blood agar at 37°C (not at 25°C or 42°C); γ-glutamyl transpeptidase and urease positive; indoxyl acetate negative; resistant to cephalothin; susceptible to nalidixic acid	57
Campylobacter vulpis sp. nov.	*Campylobacteraceae*	Cecal contents of wild red fox (*Vulpes vulpes*) from Italy	Microaerophilic, motile, oxidase-positive, catalase-negative, sigmoid-shaped, Gram-negative bacillus; 2- to 3-mm-diam gray, translucent, flat, irregular-edged, alpha-hemolytic colonies on nutrient agar supplemented with 5%	155[c]

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			sheep blood; growth observed at 37°C and 42°C (no growth at 25°C); indoxyl acetate positive; most strains reduce nitrate; ~50% of strains are alkaline phosphatase positive; urease, nitrate, and hippurate negative; does not require hydrogen supplementation; most strains grow in 1% glycine; susceptible to nalidixic acid and cephalothin	
Mollicutes				
Mycoplasma tullyi sp. nov.	*Mycoplasmataceae*	Dead Humboldt penguin (*Spheniscus humboldti*) from the United Kingdom	Pleomorphic (some are spherical and some are flask shaped), cell wall-deficient organisms that are filterable through 220- and 450-nm membranes; fried-egg-shaped colonies grow within 2 days; optimal growth at 37°C; serum or sterol required for growth; acid produced from glucose; no hydrolysis of arginine or urea; resistant to penicillin	60
Mycoplasma enhydrae sp. nov.	*Mycoplasmataceae*	Oropharynx of wild southern sea otter (*Enhydra lutris nereis*) from California	Cell wall-deficient organisms that are filterable through 220- and 450-nm membranes; fried-egg-shaped colonies on SP4 agar with arginine grow within 3–5 days; optimal growth at 35°C–37°C; serum or sterol required for growth; no acid produced from glucose; hydrolyzes arginine but not urea; resistant to penicillin	156
Mycoplasma hafezii sp. nov.	*Mycoplasmataceae*	Trachea of healthy captive adult peregrine falcon (*Falco peregrinus*)	Nonhelical, nonmotile cells that are filterable through 450-nm membranes; fried-egg-shaped colonies on solid SP4 medium grow within 24 h; optimal growth at 37°C; sterol required for growth; acid produced from glucose; no hydrolysis of arginine or urea	157
Ureaplasma miroungigenitalium sp. nov.	*Mycoplasmataceae*	Vagina of wild northern elephant seal (*Mirounga angustirostris*) from California	Cell wall-deficient organisms that are filterable through 450-nm membranes and less filterable through 220-nm membranes; tiny, rough, granular colonies on A8 agar; optimal growth at 35°C–37°C; serum required for growth; hydrolysis of urea but not arginine; resistant to penicillin and lincomycin; phylogenetic analysis of 16S rRNA and *rpoB* genes important for final differentiation	158
Ureaplasma zalophigenitalium sp. nov.	*Mycoplasmataceae*	Vagina and preputium of wild sea lion (*Zalophus californianus*) from California	Cell wall-deficient organisms that are filterable through 450-nm membranes and less filterable through 220-nm membranes; tiny, rough, granular colonies on A8 agar; optimal growth at 35°C–37°C; serum required for growth; hydrolysis of urea but not arginine; resistant to penicillin and lincomycin; phylogenetic analysis of 16S rRNA and *rpoB* genes important for final differentiation	158
Mycoplasma procyoni sp. nov.	*Mycoplasmataceae*	Oral cavity of raccoon (*Procyon lotor*) from Canada	Facultative, cell wall-deficient organisms that are filterable through 220- and 450-nm membranes; fried-egg-shaped colonies on PPLO agar with glucose grow within 5–7 days; optimal growth at 35°C–37°C; serum or sterol required for growth; acid produced from glucose; no hydrolysis of arginine or urea; resistant to penicillin G	159[o]
Mycoplasma nasistruthionis sp. nov.	*Mycoplasmataceae*	Ostrich (*Struthio camelus*) with respiratory disease	Near-spherical, nonmotile cells filterable through a 220-nm membrane; cells do not revert to walled forms in the	62[p]

(Continued on next page)

TABLE 1 (Continued)

Scientific name	Family	Source(s)	Growth characteristics[q]	Reference(s)
			absence of antibiotics; fried-egg-shaped colonies on solid medium within 48 h; optimal growth at 37°C; serum or sterol required for growth; weak acid produced from glucose; no hydrolysis of arginine, esculin, casein, gelatin, or urea	
Mycoplasma struthionis sp. nov.	*Mycoplasmataceae*	Ostrich (*Struthio camelus*) with respiratory disease	Near-spherical (some are flask shaped with tip-like structures), nonmotile cells filterable through a 220-nm membrane; cells do not revert to walled forms in the absence of antibiotics; fried-egg-shaped colonies on solid medium within 48 h; optimal growth at 37°C; serum or sterol required for growth; acid not produced from glucose; hydrolyzes arginine; no hydrolysis of esculin, casein, gelatin, or urea	62[p]

[a]Taxonomic designation subsequently accepted in validation list no. 182 (160).
[b]Taxonomic designation subsequently accepted in validation list no. 184 (161).
[c]Taxonomic designation subsequently accepted in validation list no. 201 (162).
[d]Taxonomic designation subsequently accepted in validation list no. 183 (163).
[e]Taxonomic designation subsequently accepted in validation list no. 174 (164).
[f]Taxonomic designation subsequently accepted in validation list no. 191 (165).
[g]Taxonomic designation subsequently accepted in validation list no. 189 (166).
[h]Taxonomic designation subsequently accepted in validation list no. 192 (167).
[i]Taxonomic designation subsequently accepted in validation list no. 175 (168).
[j]Taxonomic designation subsequently accepted in validation list no. 185 (169).
[k]Taxonomic designation subsequently accepted in validation list no. 198 (170).
[l]Taxonomic designation subsequently accepted in validation list no. 194 (171).
[m]Taxonomic designation subsequently accepted in validation list no. 195 (172).
[n]Taxonomic designation subsequently accepted in validation list no. 202 (173).
[o]Taxonomic designation subsequently accepted in validation list no. 193 (174).
[p]Taxonomic designation subsequently accepted in validation list no. 197 (175).
[q]MRS, De Man-Rogosa-Sharpe; ONPG, *o*-nitrophenyl-β-D-galactopyranoside.

and *Corynebacterium zhongnanshanii* sp. nov. (32). Understanding the respiratory tract microbiota of Himalayan marmots could have direct implications for public health and may influence future investigations in this host.

Streptococcus catagoni sp. nov. (26) was isolated from the lungs, tonsils, and brains of Chacoan peccaries (*Catagonus wagneri*). The Chacoan peccary is native to the Gran Chaco region of Paraguay, Bolivia, and Argentina. This species was thought to be extinct until its discovery in 1971. This host is currently under threat due to human encroachment on its territory. The type strain of *Streptococcus catagoni* sp. nov. was isolated from a young female animal with purulent pneumonia. Phylogenetic analysis determined that *S. catagoni* sp. nov. is most closely related to *Streptococcus didelphis* and can be distinguished by a positive Voges-Proskauer test and the production of acid from D-sorbitol and glycogen. *Streptococcus pacificus* sp. nov. and *Streptococcus zalophi* sp. nov. (27) were isolated from the lung tissue of a California sea lion (*Zalophus californianus*) with domoic acid toxicity. Domoic acid is a neurotoxin that is produced during blooms of the alga *Pseudonitzschia australis* and accumulates in small fish that are consumed by sea lions. Subsequent feeding may cause damage to the brain and heart and may impact the subsequent immune response mounted by the sea lion (33, 34).

Within the *Staphylococcaceae*, two new members were described in healthy animals, *Staphylococcus durrellii* sp. nov. from the oropharynx and *Staphylococcus lloydii* sp. nov. from the skin of captive Livingstone's fruit bats (*Pteropus livingstonii*) (35). Livingstone's fruit bat is an endangered bat from the Comoros Islands between Africa and northern Madagascar. These two staphylococcal species are most closely related to *Staphylococcus kloosii*. They can be differentiated from each other through the production of acetoin in the Voges-Proskauer test and the production of acid from maltose by *S. lloydii* sp. nov. Both novel species can be differentiated from *S. kloosii* through the production of urease by *S. kloosii* (35).

TABLE 2 Revised bacterial taxa relative to nondomestic wildlife animal sources of veterinary material from January 2018 through December 2021

Former name	Revised name	Other information	Reference(s)
Gram-positive bacilli			
Arthrobacter nasiphocae	*Falsarthrobacter nasiphocae* gen. nov., comb. nov.	Initial description and recovery of the former *A. nasiphocae* from common seal in reference 176	177
Limosilactobacillus reuteri	*Limosilactobacillus reuteri* subsp. *kinnaridis* subsp. nov.	Initial description and recovery of *Lactobacillus reuteri* in reference 178 and accepted in reference 179; taxon transitioned to *Limosilactobacillus* genus designation in 2020, as described in reference 180; *L. reuteri* subsp. *kinnaridis* subsp. nov. observed in the gastrointestinal tract of a pheasant	145
Actinomyces liubingyangii	*Boudabousia liubingyangii* comb. nov.	Initial description and recovery of the former *A. liubingyangii* from vulture (*Gypaetus barbatus*) in reference 181	30
Actinomyces tangfeifanii	*Boudabousia tangfeifanii* comb. nov.	Initial description and recovery of the former *A. tangfeifanii* in reference 78 (Table 1)	30
Actinomyces marimammalium	*Boudabousia marimammalium* comb. nov.	Initial description and recovery of the former *A. marimammalium* from 2 dead seals and a porpoise in reference 67	68[a]
Gram-negative bacilli and coccobacilli			
Flavobacterium ceti	*Myroides ceti* comb. nov.	Initial description and recovery of the former *F. ceti* from beaked whales (*Ziphius cavirostris*) in reference 182	183[b]
Duganella danionis	*Pseudoduganella danionis* sp. nov.	Initial description and recovery of the former *D. danionis* from beaked whales in reference 184 and accepted in reference 185; initial description and recovery of *P. danionis* from zebrafish in reference 186; *D. danionis* is a later homotypic synonym of *P. danionis*	186
Jinshanibacter xujianqingii	*Insectihabitans xujianqingii* comb. nov.	Initial description and recovery of the former *J. xujianqingii* in reference 129 (Table 1)	187
Pseudomonas hussainii	*Atopomonas hussainii* comb. nov.	Initial description and recovery of the former *P. hussainii* from seashore bird droppings in reference 188	189
Gram-positive anaerobes			
Asaccharobacter celatus	*Adlercreutzia equolifaciens* subsp. *celatus* subsp. nov.	Initial description and recovery of the former *A. celatus* from rat cecum in reference 190	68[a]
Gram-negative anaerobes			
Bacteroides chinchillae	*Phocaeicola chinchillae* comb. nov.	Initial description and recovery of the former *B. chinchillae* from chinchilla (*Chinchilla lanigera*) feces in reference 191	183[b]
Spirochetes			
Borrelia bavariensis	*Borrelia garinii* subsp. *bavariensis*	Initial description and recovery of the former *B. bavariensis* in reference 192 and accepted in reference 193; the significance of this organism in oceanic avian species is discussed in reference 194	195[c]
Mollicutes			
Mycoplasma lagogenitalium	*Mesomycoplasma lagogenitalium* comb. nov.	Initial description and recovery of the former *M. lagogenitalium* from preputial smegma of Afghan pika (*Ochotona rufescens rufescens*) in reference 65	61[a]

(Continued on next page)

TABLE 2 (Continued)

Former name	Revised name	Other information	Reference(s)
Mycoplasma moatsii	*Mesomycoplasma moatsii* comb. nov.	Initial description and recovery of the former *M. moatsii* from imported grivet monkeys (*Cercopithecus aethiops*) in reference 196	61[a]
Mycoplasma phocicerebrale	*Metamycoplasma phocicerebrale* comb. nov.	Initial description and recovery of the former *M. phocicerebrale* from harbor seals (*Phoca vitulina* L.) in reference 197	61[a]
Mycoplasma agassizii	*Mycoplasmopsis agassizii* comb. nov.	Initial description and recovery of the former *M. agassizii* from upper respiratory tract specimens of 2 species of tortoises (*Gopherus* spp.) in reference 198	61[a]
Mycoplasma felifaucium	*Mycoplasmopsis felifaucium* comb. nov.	Initial description of the former *M. felifaucium* from puma respiratory tract specimens in reference 199 and accepted in reference 200	61[a]
Mycoplasma alligatoris	*Mycoplasmopsis alligatoris* comb. nov.	Initial description of the former *M. alligatoris* from alligator polyserositis and multifocal arthritis involving multiple organs (peripheral blood, synovial fluid, and cerebrospinal fluid specimens) in reference 66	61[a]
Mycoplasma phocirhinis	*Mycoplasmopsis phocirhinis* comb. nov.	Initial description and recovery of the former *M. phocirhinis* from harbor seals (*Phoca vitulina* L.) in reference 197	61[a]
Mycoplasma microti	*Malacoplasma microti* comb. nov.	Initial description and recovery of the former *M. microti* from prairie vole (*Microtus ochrogaster*) in reference 201	61[a]
Mycoplasma neophronis	*Metamycoplasma neophronis* comb. nov.	Initial description and recovery of the former *M. neophronis* from the upper respiratory tract of Canarian Egyptian vultures (*Neophron percnopterus majorensis*) in reference 202	61[a]
Mycoplasma ciconiae	*Mycoplasmopsis ciconiae* comb. nov.	Initial description and recovery of the former *M. ciconiae* from the trachea of white stork nestlings (*Ciconia ciconia*) in reference 203 and accepted in reference 204	61[a]

[a]Taxonomic designation subsequently accepted in validation list no. 184 (161).
[b]Taxonomic designation subsequently accepted in validation list no. 193 (174).
[c]Taxonomic designation subsequently accepted in validation list no. 194 (171).

Within the Gram-positive bacilli, *Corynebacterium silvaticum* sp. nov. was identified from lesions consistent with caseous lymphadenitis, including lamellar lymph node abscesses with an "onion ring" appearance in wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*) from Germany (36). Wild boar and roe deer are commonly hunted animals and are important economically and as a human food source. *Corynebacterium silvaticum* sp. nov. is most closely related to *Corynebacterium ulcerans* and *Corynebacterium pseudotuberculosis*, both of which are human pathogens, with *C. pseudotuberculosis* being a significant pathogen in small ruminants and horses (37–39). *C. silvaticum* sp. nov. is similar to *C. ulcerans* in that it ferments glucose, ribose, and maltose but (similar to *C. pseudotuberculosis*) does not utilize D-xylose, mannitol, lactose, sucrose, and glycogen (36).

Gram-negative bacilli and coccobacilli comprise one of the largest groups of organisms routinely isolated from veterinary patients. A notable example from the taxa presented in Table 1, *Bartonella kosoyi* sp. nov., was isolated from the blood of black rats (*Rattus rattus*) from Israel (40). The genus *Bartonella* includes nearly 40 species at the time of writing, with these organisms being hemotropic, facultative, intracellular bacteria that are transmitted by arthropod vectors (40). *Bartonella kosoyi* sp. nov. is most closely related to the zoonotic species *Bartonella elizabethae* (41). *B. elizabethae* has previously been reported from dogs (*Canis lupus* subsp. *familiaris*) (42). Although there are currently no reported human cases of infection by *B. kosoyi* sp. nov., it has now been isolated from rodents from Thailand, Sri Lanka, Myanmar, and the Canary Islands (43–45).

Another novel Gram-negative bacillus is *Lysobacter pythonis* sp. nov. (46), isolated from the respiratory tract of a python (*Python regius*) experiencing respiratory distress, and a second isolate was obtained from a python with a respiratory infection following antibiotic therapy. 16S rRNA gene, 16S-23S intergenic spacer region, and *groEL* sequences from both isolates were found to be most similar to those of *Lysobacter tolerans*, although similarities to *Luteimonas aestuarii* and *Luteimonas mephitis* were noted (46). Colonies of *L. pythonis* sp. nov. are nonhemolytic and yellow and do not grow on MacConkey agar but do grow weakly on Sabouraud agar. Phenotypic differentiation between *L. pythonis* sp. nov. and closely related and similar organisms required several biochemical tests, including the assimilation of acetate, *trans*-aconitate, citrate (weakly), DL-lactate, oxoglutarate, and pyruvate (46).

Within the *Pasteurellaceae* are two novel organisms that cause pneumonia in birds, *Spirabiliibacterium falconis* comb. nov., isolated from a kestrel (*Falco tinnunculus*) with bronchopneumonia, and *Spirabiliibacterium pneumoniae* comb. nov., isolated from a pigeon hawk (*Falco columbarius*) (47). These two organisms were previously classified as belonging to Bisgaard taxon 14, which included bacteria from birds with respiratory tract infections (48). Bisgaard and Christensen (47) provided a highly informative, substantive review of changes in nomenclature within taxa 14 and 32. They also established the *S. falconis* comb. nov. and *S. pneumoniae* comb. nov. taxa based on 16S rRNA gene analysis and whole-genome sequencing and provided supportive phenotypic data that differentiate these two organisms from each other and their close relative *Spirabiliibacterium mucosae* sp. nov.

Rickettsia monacensis sp. nov. (49) is an obligate intracellular organism that was initially recovered in 2002 from *Ixodes ricinus* ticks in Europe and was recently reported in bats as well as an apparently healthy dog from Cape Verde (50). *R. monacensis* sp. nov. is a member of the spotted fever group that causes Mediterranean spotted fever in humans and has been reported from dogs, bats, and a migratory songbird captured in Texas (51–55). The identification of *R. monacensis* sp. nov. in a tick found on a migratory bird highlights the potential for the expansion of the range of this organism.

Helicobacter enhydrae sp. nov., *Helicobacter monodelphidis* sp. nov., and *Helicobacter didelphidarum* sp. nov. (56, 57) are selected curved bacteria listed in Table 1. *H. enhydrae* sp. nov. was isolated from inflamed tissue from the gastric body of a southern sea otter (*Enhydra lutris*) from California but was nonvalidly published as "*H. enhydrae* sp. nov." until 2020 (56). *Enhydra lutris* is a threatened species that has been slow to recover due to substantial infectious disease challenges. In addition to the valid publication of *H. enhydrae* sp. nov., Shen et al. describe the impact of bacterial populations on *E. lutris* and the origin of the tissues from which *H. enhydrae* sp. nov. was originally isolated (56). *H. monodelphidis* sp. nov. and *H. didelphidarum* sp. nov. (57) were isolated from the colons of gray short-tailed opossums (*Monodelphis domestica*) with cloacal prolapse. Gray short-tailed opossums are a widely used laboratory animal species, and cloacal (rectal) prolapse has been described as a common health problem in laboratory-reared opossums (58, 59). In a study of 94 opossums from two different colonies, 40 helicobacter strains were isolated (57). Of these isolates, 25 were *H. monodelphidis* sp. nov., while the remaining 15 isolates were *H. didelphidarum* sp. nov. based on 16S rRNA gene, *hsp60*, and *gyrB* analyses. Detailed descriptions and images of the lesions were provided, along with detailed histories of the animals and the disease. These novel *Helicobacter* spp. should be considered in gray short-tailed opossums with rectal prolapse.

Within the class *Mollicutes*, three novel *Mycoplasma* species associated with disease in avian species were described. *Mycoplasma tullyi* sp. nov. was isolated from the liver of a deceased 10-day-old Humboldt penguin (*Spheniscus humboldti*) in the United

Kingdom (60). While it was unclear how the organism infected the penguin chick, the isolation of this organism as the sole agent from the liver supports the hypothesis that it was associated with disease in this host. *M. tullyi* sp. nov. was also isolated as part of the mixed upper respiratory tract microbiota from healthy adult Humboldt penguins. In initial pathogenesis studies, *M. tullyi* sp. nov. caused ciliostasis in chicken embryo tracheal organ cultures and caused mortality and stunting of growth in embryonated chicken egg tests (60). *M. tullyi* sp. nov. is most closely related to *Mycoplasma gallisepticum*, the taxonomy of which has recently been revised to *Mycoplasmoides gallisepticum* comb. nov. (61).

Similarly, in a study of 10 ostriches with respiratory disease from farms in Namibia, *Mycoplasma nasistruthionis* sp. nov. and *Mycoplasma struthionis* sp. nov. (62) were isolated from 2 different ostriches (*Struthio camelus*). *M. nasistruthionis* sp. nov. is most closely related to *Mycoplasma verecundum*, now known as *Mycoplasmopsis verecunda* comb. nov. (61, 62). *M. struthionis* sp. nov. is most closely related to *Mycoplasma falconis*, the taxonomy of which has transitioned to *Metamycoplasma falconis* comb. nov. (61, 62). In light of additional changes to *Mycoplasma* spp. described in Table 2, it seems likely that the designations of *M. tullyi* sp. nov., *M. nasistruthionis* sp. nov., and *M. struthionis* sp. nov. may undergo revision at the genus level.

Taxonomic revisions. As alluded to above, a major revision to the phylogenetic framework within the phylum "*Tenericutes*" (recently reclassified as the phylum *Mycoplasmatota* [63]) was based on the evaluation of the genome sequences of 140 members of the phylum (61). The novel order *Mycoplasmoidales* was proposed to include the families *Metamycoplasmataceae* fam. nov. and *Mycoplasmoidaceae* fam. nov. Included within *Metamycoplasmataceae* fam. nov. were the newly proposed genera *Mesomycoplasma* gen. nov., *Metamycoplasma* gen. nov., and *Mycoplasmopsis* gen. nov. *Mycoplasmoidaceae* fam. nov. included the newly proposed genera *Malacoplasma* gen. nov. and *Mycoplasmoides* gen. nov. Species names were maintained, and the novel genus designations carry the same first letter as *Mycoplasma*, simplifying the transitions listed in Table 2. Revised taxa impacting domestic veterinary hosts have been summarized in a recent report (11), while additional revisions for the class *Mollicutes* were reviewed previously (64). The class *Mollicutes* affects a wide variety of wildlife species in a variety of ways, from being present in the urogenital tract of healthy Afghan pikas (65) to causing polyserositis and multifocal arthritis in alligators (66). The broad impact of these organisms on animals and the magnitude of the changes to the phylum make this likely the most significant nomenclature revision discussed in this report.

In addition to changes in *Mycoplasma* spp., organisms that cause disease in wildlife have undergone taxonomic revision. Notably, *Actinomyces marimammalium*, which was originally isolated from two dead seals and a porpoise (67), has transitioned from the *Actinomyces* genus to *Boudabousia marimammalium* comb. nov. (68). This organism was originally isolated from multiple organs (lung, spleen, liver, kidney, and mesenteric lymph node) of a dead male hooded seal (*Cystophora cristata*) that had pneumonia, the lung of a dead harbor porpoise (*Phocoena phocoena*), and the small intestine of a dead gray seal (*Halichoerus grypus*) that was shot (67). Although speculative, the presence of this organism in the intestine of an otherwise healthy gray seal that died from trauma, the respiratory tract of a porpoise, and multiple locations in a seal with pneumonia suggests that this organism may be an opportunistic rather than a primary pathogen.

CONCLUSION

While the numerous changes in the taxonomy of bacteria isolated from wildlife represent a challenge for veterinary microbiology laboratories, detailed genetic knowledge of these bacteria and their relationships with better-studied organisms may offer insights into their roles in their wildlife hosts. Given the challenges of studying bacterial pathogenesis in wildlife, the results of these comprehensive phylogenetic studies may provide clues to help those who manage and care for these unique animal populations and ultimately may promote ecosystem health. Here, we strive to summarize the additions and changes to the taxonomy of bacteria associated with wildlife from 2018 through 2021 and to provide insights into the relevance of these agents in their host species. The continuing efforts to describe the microbiota in various animal species and to determine the clinical significance of novel organisms indicate that this effort will be sustainable in the future.

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