

Supplementary Table S1

Study locations (country/region), assigned Köppen–Geiger climate class (approximate; see Beck et al., 2018) [1], and the climatic covariates and temporal windows used for inference.

Vector group	Vector	Pathogen/system	Study location (country/region)	Köppen–Geiger climate class (code)	Climatic covariates used (as reported)	Temporal window/lag	Relevance to this review (stage model/context)	Ref
Mosquito	<i>Culex pipiens</i> complex	West Nile virus	Europe (multi-country)	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Eco-climatic predictors (temperature/moisture anomalies; environmental indices) in outbreak prediction	seasonal/annual (as reported)	Amplification early warning (climate → outbreak probability)	[2]
Mosquito	<i>Culex pipiens</i>	West Nile virus	Italy (Emilia-Romagna)	Cfa (humid subtropical, Po Valley) / Cfb (uplands)	Meteorological + environmental drivers of mosquito infection prevalence (time series)	multi-year	Amplification (infection prevalence responds to the meteo-environment)	[3]
Mosquito	<i>Culex pipiens</i>	West Nile virus lineage 2	Spain (NE)	Csa/Csb (mediterranean) + Cfb (north)	Seasonal persistence across years (climate/seasonality context)	winter; seasonal/annual (as reported)	Establishment/overwintering inference	[4]
Mosquito	<i>Culex pipiens</i>	West Nile virus (vector ecology)	Italy (Central)	Cfa (humid subtropical, Po Valley) / Cfb (uplands)	Characterization of overwintering sites (hibernacula microenvironment)	winter; experimental (temperature regimes)	Overwintering biology (mechanistic specificity)	[5]
Mosquito	<i>Aedes albopictus</i>	Establishment risk	Urban temperate Europe	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Microclimatic winter conditions (urban thermal buffering)	winter; seasonal/annual (as reported)	Establishment gate (microclimate vs coarse climate)	[6]
Mosquito	<i>Aedes albopictus</i>	Dengue/chikungunya (Europe)	Europe	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Climate + vector establishment as predictors in a time-to-event framework	seasonal/annual (as reported)	Stage logic: establishment + climate → outbreak hazard	[7]
Tick	<i>Ixodes ricinus</i>	<i>Borrelia</i> spp.	UK (southern England)	Cfb (oceanic, dominant)	Urban–rural gradient context; environment/microclimate implicitly structured by land cover	seasonal/annual (as reported)	Avoid over-generalization (risk not monotonic with urbanization)	[8]
Tick	<i>Ixodes ricinus</i>	Thermal suitability	Europe (long-term)	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Thermal limit shift (temperature-based suitability boundary)	seasonal/annual (as reported)	Range/phenology climate linkage	[9]
Tick	<i>Ixodes scapularis</i>	<i>Borrelia burgdorferi</i> s.s.	North America (residential–woodland gradient)	Temperate (mixed)	Fine-scale habitat gradient as proxy for microclimate exposure context	seasonal/annual (as reported)	Spillover interface (peri-domestic risk gradients)	[10]
Tick	<i>Ixodes scapularis</i>	<i>Borrelia burgdorferi</i> s.s.	North America	Temperate (mixed)	Host management effects; climate is not the sole driver	seasonal/annual (as reported)	Host specificity: deer affect ticks, not necessarily infection prevalence	[11]

Tick	<i>Ixodes ricinus</i>	Population dynamics	Europe (longitudinal field surveys)	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Mechanistic modeling using climate covariates + field time series	multi-year	Driver precision (explicit climate terms in models)	[12]
Sandfly	<i>Phlebotomus</i> spp.	Distribution (France)	France (temperate margin + Mediterranean)	Cfb (oceanic) / Csa (mediterranean, south) / Dfb (NE)	Distribution/abundance synthesis; climate context discussed	seasonal/annual (as reported)	Specific geography (where sandflies occur in temperate France)	[13]
Sandfly	<i>Phlebotomus mascittii</i>	Presence updates	Southwest Germany	Cfb (oceanic) / Dfb (continental, parts)	Northern-edge occurrence; climate context (temperate margin)	seasonal/annual (as reported)	Establishment hypothesis (repeated detections at new locations)	[14]
Sandfly	<i>Phlebotomus</i> spp.	Toscana virus / Leishmania	Northern Italy (lowlands)	Cfa (humid subtropical, Po Valley) / Cfb (uplands)	Seasonal dryness/hydroclimate framing for abundance	seasonal/annual (as reported)	Amplification (hydroclimate as a seasonal amplifier)	[15]
Sandfly	<i>Phlebotomus perniciosus</i>	Toscana virus	Lab–mechanistic		Temperature-dependent intra-vector dynamics (EIP context)	seasonal/annual (as reported)	Pathogen-vector biology (omit vague statements)	[16]
Sandfly	(multiple)	Leishmania infantum autochthony (Europe)	Europe	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Estimated distribution across 2005–2020; climate suitability context	seasonal/annual (as reported)	Where autochthony is supported	[17]
Biting midge	<i>Culicoides</i> spp.	Schmallenberg virus	Denmark (cattle farms)	Cfb (oceanic, dominant)	Microclimatic farm temperatures used to derive transmission potential	seasonal/annual (as reported)	Microclimate operationalization (farm-level)	[18]
Biting midge	<i>Culicoides</i> spp.	Flight activity constraints	UK	Cfb (oceanic, dominant)	Thermal limits for flight activity (lab-defined; field-collected)	experimental (temperature regimes)	Biology specificity (flight thresholds vary by complex)	[19]
Biting midge	<i>Culicoides</i> spp.	Bluetongue virus	(modeling; livestock context)		Temperature-dependent suitability of transmission	seasonal/annual (as reported)	Amplification window (temperature → suitability)	[20]
Biting midge	<i>Culicoides</i> spp.	BTV-3 / SBV	Germany	Cfb (oceanic) / Dfb (continental, parts)	Vector pool detection during epidemic context; seasonality implied	seasonal/annual (as reported)	Transmission-relevant surveillance (beyond “vector present”)	[21]
Biting midge	<i>Culicoides</i> spp.	Winter activity	Germany (stables vs outdoors)	Cfb (oceanic) / Dfb (continental, parts)	Indoor–outdoor thermal buffering framing	winter; seasonal/annual (as reported)	Overwintering/persistence plausibility	[22]
Biting midge	<i>Culicoides</i> spp.	Bite prevention	Temperate farm setting	Temperate (varies)	Vector-proof accommodation effectiveness (exposure reduction)	seasonal/annual (as reported)	Control feasibility (farm-level intervention)	[23]
Mosquito	<i>Culex</i> spp.	West Nile virus	Europe (projection study)	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Climate-change projections of WNV transmission suitability (temperature-driven, scenario-based)	future scenarios (multi-decade)	Provides map-based climate suitability/projection framing for temperate WNV risk	[24]
Mosquito	<i>Culex</i> spp.	West Nile virus	Modeling (temperature-driven transmission limits)		Temperature effects on boundary conditions of WNV transmission (mechanistic / model-based)	temperature-dependent; seasonal applicability	Strengthens the mechanistic link between temperature and WNV transmission potential	[25]
Mosquito	<i>Culex</i> spp.	West Nile virus	Europe	Mixed temperate (Cfb/Dfb/Csa/Cfa)	Climate-linked spatial expansion analysis (map-	multi-year (historical + recent)	Provides map-based evidence linking climate trends to WNV spatial expansion	[26]

					based); climatic suitability drivers			
Mosquito	Aedes albopictus	Overwintering ecology	Temperate urban microhabitats (tires)		Microhabitat thermal buffering (snow-covered tires) enables overwintering	winter	Adds concrete microclimate parameterization for overwintering survival	[27]
Tick	Ixodes ricinus	Microclimate constraints / ecological barriers	Europe (microclimate barrier study)	Mixed temperate (Cfb/Dfb)	Temperature and relative humidity patterns associated with ecological barriers to tick activity	seasonal / microclimate	Adds explicit temperature/RH covariates for tick persistence/establishment	[28]

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