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A worldwide and annotated database of evaporative water loss rates in squamate reptiles

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Running head: SquamEWL: a database of evaporative water loss in reptiles

Biosketch

25 **Jean-François Le Galliard** is an evolutionary biologists and population ecologist interested in the
26 understanding the diversity of life history and behavioral strategies that animals use to survive and
27 reproduce in their changing environment. For this data project, he worked with a team of ecologists
28 and evolutionary biologists with strong expertise in the ecophysiology and water biology of reptiles.

29

30 **Authors contributions**

31 JFLG and TVD conceived the project, organized the data collection, and collected and checked
32 data. FB, AD, RG and OL contributed to project conception and helped with data collection and
33 management. MA, MS and DOVA contributed data and helped with data collection. CC helped with
34 data collection, data formatting and technical validation. All authors contributed to writing based on
35 a first version produced by JFLG.

36

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50 **Abstract**

51 **Motivation:** The understanding of physiological adaptations, of evolutionary radiations and of
52 ecological responses to global change urges for global, comprehensive databases of the functional
53 traits of extant organisms. The ability to maintain an adequate water balance is a critical functional
54 property influencing the resilience of animal species to climate variation. In terrestrial or semi-
55 terrestrial organisms, total water loss includes a significant contribution of evaporative water loss
56 (EWL). The analysis of geographic and phylogenetic variation in EWL rates must however account
57 for differences in methods and potential confounding factors which influence standard measures of
58 whole-organism water loss. We compiled the global and standardized SquamEWL database of total,
59 respiratory and cutaneous EWL for 325 species and sub-species of squamate reptiles (793 samples
60 and 2536 estimates) from across the globe. An extensive set of companion data and annotations
61 associated to the EWL measurements of potential value for future investigation, including
62 metabolic rate data, is provided. We present preliminary descriptive statistics for the compiled data,
63 discuss gaps and biases, and identify promising avenues to update, expand and explore this
64 database.

65 **Main types of variables contained:** standard water loss rates, geographic data, metabolic rates.

66 **Spatial location:** global.

67 **Time period:** data were obtained from extant species and were collected between 1945 and 2020.

68 **Major taxa:** Reptilia, Squamata including lizards, snakes and amphisbaenians.

69 **Level of measurements:** individual samples of animals from the same species, locality, age class
70 and sex category.

71 **Software format:** csv.

72 **Keywords:** ectotherms, functional traits, homeostasis, hydoregulation, macrophysiology,
73 evaporative water loss.

74 **1. Background and summary**

75 The ecological niche of a species is an important concept in correlative species distribution
76 modeling and describes the multivariate environmental space of abiotic and biotic factors that
77 determine the boundaries of a species range (Chase & Leibold, 2003). In mechanistic species
78 distribution models, however, the ecological niche of a species is not inferred from its realized niche
79 but derived from a calculation of the fundamental niche of the organism, defined as the full range of
80 conditions and resources suitable for survival and reproduction (Kearney & Porter, 2009). In the last
81 decade, mechanistic models have become central to uncover the potential effects of global climatic
82 change on species viability and distribution (Sinervo *et al.*, 2010; Boyle *et al.*, 2020). Since
83 properties of the fundamental niche are determined by organismal traits, current research aims to
84 better understand how morphological, physiological and behavioral properties of organisms
85 constrain their fundamental niche and ultimately define their ecological niche and distribution.

86 The compilation of databases of functional traits, defined as the morphological,
87 physiological, phenological or behavioral traits that determine the performance of individuals
88 (Violle *et al.*, 2007; Kearney *et al.*, 2021), is a fundamental step in this research program (Schneider
89 *et al.*, 2019). Furthermore, global databases of functional traits can be used to investigate universal
90 scaling rules and advance our understanding of evolutionary processes (Díaz *et al.*, 2016; Etard *et*
91 *al.*, 2020). Research on the climatic tolerances of ectothermic animals over the last decades has
92 focused on the study of functional traits characterizing the thermal biology, including thermal limits
93 (Sunday *et al.*, 2012; Bennett *et al.*, 2018), thermal performance curves and metabolism (Dillon *et*
94 *al.*, 2010), thermoregulation behavior (Kearney *et al.*, 2009), or thermal sensitivity of development
95 (Noble *et al.*, 2018). However, studies have shown that traits associated with water balance in
96 ectotherms are also critical in setting their climatic niche, their sensitivity to global changes, and
97 their macro-evolutionary radiation patterns (Brischoux *et al.*, 2012; Kearney *et al.*, 2018; Garcia-

98 Porta *et al.*, 2019; Gouveia *et al.*, 2019; Rozen-Rechels *et al.*, 2019; Lertzman-Lepofsky *et al.*,
99 2020).

100 In animals, water balance is dynamically regulated by the constant adjustments of water loss
101 and water intake processes (Figure 1A) which depend on morphological features and physiological
102 and behavioral mechanisms (e.g., behavioral hydoregulation, skin resistance to water loss or
103 respiration, Chown *et al.*, 2011; Pintor *et al.*, 2016; Pirtle *et al.*, 2019; Riddell *et al.*, 2019). As a
104 result, body hydration state is homeostatically maintained within a safety zone by compensating
105 water loss with input from metabolic, food and drinking water to avoid the acute and chronic,
106 potentially lethal, effects of dehydration. Total evaporative loss (TEWL) comprises both the water
107 lost through the skin epidermis or exoskeleton (cutaneous water loss, CWL) and via the respiratory
108 system (respiratory water loss, RWL). Although functional traits such as desiccation resistance and
109 behavioral traits are also important for hydoregulation, the standard rate of EWL has proven to be a
110 relevant metric to assess water regulation strategies, and to scale the susceptibility of organisms to
111 drought, habitat aridity or salinity in birds (Albright *et al.*, 2017; Boyle *et al.*, 2020), mammals (Van
112 Sant *et al.*, 2012), non-avian reptiles (Brischoux *et al.*, 2012; Cox & Cox, 2015), amphibians
113 (Lertzman-Lepofsky *et al.*, 2020) and insects (Addo-Bediako *et al.*, 2001). However, to our
114 knowledge, there has been no attempt to compile and annotate a global database of all published
115 EWL records in terrestrial animals, including those of squamate reptiles.

116 Squamate reptiles share proximate mechanisms of water loss (Mautz, 1982). They are ideal
117 model systems to study the relevance of water regulation strategies under a macroecological
118 mechanistic approach since these dry-skinned ectothermic organisms exhibit great phylogenetic and
119 ecological diversification, broad variation in body size and shape, and are found in most habitats
120 across the globe (Meiri, 2018). In addition, their performance and life history strategies are greatly
121 influenced by the availability of water in their environment (Kearney & Porter, 2004; Lillywhite,
122 2017; Rozen-Rechels *et al.*, 2020). Rates of TEWL vary with micro-climatic conditions,

123 morphological and functional adaptations, life stages and behavioral strategies (e.g., space use and
124 activity, Pirtle *et al.*, 2019). In squamates, EWL is not as tightly associated with body temperature
125 regulation as in endothermic animals. Indeed, heat loss due to CWL and RWL, i.e., evaporative
126 cooling, is generally negligible in squamate reptiles, except under extreme conditions such as
127 panting in some desert species or under extreme heat stress (Tattersall *et al.*, 2006; Loughran &
128 Wolf, 2020). Although CWL is generally the dominant avenue of water loss in squamate reptiles,
129 the partitioning between RWL and CWL, which includes trans-epidermal, ocular and cloacal water
130 loss, varies between and within species (Mautz, 1982; Pirtle *et al.*, 2019). One important factor
131 affecting the partitioning between CWL and RWL is body size, which is largely determined by the
132 fact that surface area and skin thickness (the primary determinants of CWL) scale differently with
133 body size than respiration rate and lung size (primary determinants of RWL, Mautz, 1980, 1982) do.
134 Changes in patterns and rates of EWL can rapidly evolve in squamates, and there is evidence of
135 adaptive plastic responses of TEWL to fluctuating temperatures or hydric conditions (Kattan &
136 Lillywhite, 1989; Moen *et al.*, 2005; Cox & Cox, 2015; Garcia-Porta *et al.*, 2019; Sannolo *et al.*,
137 2020). Yet, estimates of TEWL are influenced by methodological choices, sampling methods (e.g.,
138 size class or seasonal factors), acclimation procedures and statistical reporting methods, which
139 makes comparisons across studies difficult without an unambiguously defined vocabulary and a
140 broad set of standardized metadata (see Figure 1B).

141 Here, we assembled a global and annotated database of rates of evaporative water loss in
142 squamate reptiles of the world using published information and unpublished data we collected in
143 recent years. Our initiative differs from previously published data sets by (1) its broad taxonomic
144 scope spanning all available data for all squamate reptiles including lizards, snakes and
145 amphisbaenians, (2) its exhaustiveness since we gathered all identified published estimates from a
146 pre-established list of acceptable methodologies and recorded samples and units from the original
147 publications without *a priori* exclusion of particular data or *ad hoc* calculations of statistics, and (3)

148 its comprehensiveness since we compiled information on 30 metadata variables. We provide a
149 computing script to facilitate future use of these data. Whenever available, we recovered and report
150 all the variables necessary for the calculation of skin resistance to evaporation R_s , a functional trait
151 relevant to the predictive modeling of water-flow balance (Kearney *et al.*, 2021) and of central
152 relevance in mechanistic niche distribution models (Riddell *et al.*, 2017). We also compiled a
153 second companion database on metabolic rate (VO_2 and VCO_2) for those cases in which this
154 information was also available on the same source material examined for the construction of the
155 EWL database. We judge this companion database relevant under the primary goal of this paper,
156 since it may ease future studies focusing on the partitioning between CWL and RWL (Gates, 1980;
157 Pirtle *et al.*, 2019).

158 We make the compiled database freely available to stimulate future research on water
159 balance in reptiles, particularly on water conservation mechanisms and even more so on the
160 geographic, ecological, and phylogenetic correlates of evaporative water loss. We expect to
161 encourage other researchers to work on the expansion of the database and consult it to identify
162 understudied groups and which set of variables are relevant to be measured and reported. Finally,
163 we hope that our database will be useful for those willing to use it to construct mechanistic niche
164 models (Kearney & Porter, 2020)

165 **2. Methods and dataset**

166 We searched for published literature and referenced reports providing potential data on water loss
167 rates in squamate reptiles in Web of Science and Google Scholar using relevant search terms in title,
168 abstract and content with the following query: (“water loss” OR “water balance” OR
169 ”hydroregulation”) AND (“reptile*” OR “snake*” OR “lizard*” OR “squamate*”). In addition, we
170 extracted all references from a recent comparative analysis of water loss in reptiles (Cox & Cox,
171 2015). The availability of water loss data on samples of individuals (excluding eggs or embryos)

172 from known reptile species was then checked by a single person (JFLG) who stored all such
173 references, source files as well as available online data in a Zotero group library (see
174 <https://tinyurl.com/y2nclru5>). Using tags, all publications were then assigned to a single person who
175 oversaw confirming availability of water loss data, extracting the data and adding relevant metadata
176 to a spreadsheet. If additional relevant publications were identified, those were added to the Zotero
177 library and processed by the same individual. This procedure was performed first in September
178 2018 and repeated in October 2019, February 2020, and September 2020 and spans data sources
179 published from 1932 to late 2020. Additionally, unpublished data were also contributed by our
180 research group. In March 2021, we added metadata following up on review requests, extracted
181 additional information on metabolism and validated the database again.

182 We produced a library of 160 publications, reports or academic contributions (monographs,
183 dissertations and theses) from which we extracted complete or partial data (see PRISMA workflow
184 in Supplementary File 1). EWL data were then added into a spreadsheet together with all the
185 available metadata describing the relevant conditions of water loss measurements, species and
186 sample characteristics, and contextual information regarding animal morphology, location, sampling
187 dates and habitat. The species and subspecies identities were standardized using the EMBL/EBI
188 Reptile DataBase release of December 21, 2019 (Uetz & Etzold, 1996). We performed data
189 extraction accepting a sample data point as defined by a unique group of animals composed of a
190 fixed set of individuals, subjected to the same experimental protocol, and measured under the same
191 conditions. For each sample, we extracted the mean and dispersion statistics (SD, SE or range) of
192 EWL rates (total water loss, respiratory water loss or cutaneous water loss) and the mean and
193 dispersion statistics (SD, SE, or range) of body mass as well as mean statistics for body size (snout
194 to vent and total length) and body surface area. Data were taken from published or shared datasets,
195 extracted from tables and text, or extracted from figures using scanned images of the plots and the
196 Plot Digitizer program in Java (<https://sourceforge.net/projects/plotdigitizer/>). Information on

197 measurement method, temperature (air, skin surface and core body temperature), water vapor
198 pressure deficit (VPD) in the air, air flow, measurement duration, and activity statuses of animals
199 were extracted whenever available or requested from the corresponding authors. We added
200 additional information on chamber characteristics and average diameter of the chambers to make it
201 possible to calculate air velocity from air flow. All data is presented as values on the scales chosen
202 for reporting, although, whenever possible, the possibility for scale conversion is provided (see
203 below). These metadata were selected because they provide important contextual information about
204 dominant factors of methodological variation in measurements of EWL (Mautz, 1980).

205 A mechanistic understanding of water balance requires a careful quantification of the
206 functional traits governing variation in CWL and RWL among species and the use of biophysical
207 models of EWL (Gates, 1980; Kearney & Porter, 2009; Pirtle *et al.*, 2019). In RWL, water is lost by
208 evaporation from the lung respiratory surface to air contained in it at a rate determined by the water
209 vapor density gradient. The establishment of the water vapor density gradient, in turn, depends on
210 the relative humidity and temperature of the inhaled air and the pace at which the air inside the
211 lungs is renewed, i.e., total ventilation (Gates, 1980). Total ventilation is determined by a
212 combination of breathing frequency and tidal volume and is linked to the adequate match of
213 metabolic demand (Pirtle *et al.*, 2019). Thus, RWL should increase monotonically with air
214 temperature, air dryness, body temperature, and increased metabolic activity. CWL is mostly
215 determined by the water vapor gradient between the skin surface and the air, which is established by
216 the interaction of air temperature and relative humidity, air convection rate, an animal's shape and
217 size, both affecting skin surface area, and, finally, the intrinsic resistance of the skin to evaporative
218 water loss or R_s (Gates, 1980; Mautz, 1980). Thus, from a functional standpoint, R_s informs on a
219 central organismal determinant of the animal's susceptibility to lose water via evaporation being,
220 possibly, the best standardized metric to compare samples, populations and species (Gates, 1980;
221 Pirtle *et al.*, 2019). Several studies have quantified and compared R_s among closely related

squamate reptile species (Dmi'el, 1998, 2001; Oufiero & Van Sant, 2018), but accurate values of R_s are generally unavailable for most species to date (Mautz, 1982). Therefore, for those cases in which the information could be recovered, we collected and reported all the components necessary for calculating R_s , even though we have not added it as a singled-out variable in the dataset (Kearney & Porter, 2020). Note that there are potential caveats with respect to this approach because of unknowns in the regional variation of skin and body temperatures (Barroso *et al.*, 2016), difficulties to partition sub-components of EWL (Senzano & Andrade, 2018), and further study or species-specific features (Mautz, 1982).

We also included variables describing study design (groups and treatments) and a quality score permitting the exclusion of data (abnormal animals, animals maintained under manipulated conditions or measurements performed in non-standard conditions) in future extraction and analysis. Each of us scored a study data quality ranging from high (appropriate protocols, protocols are well reported, and data statistics are detailed), medium (one item is missing) to low (poorly designed, poorly reported protocols and poorly detailed data statistics). The same person also scored the data standards as either usable to not usable data (because of low study standards or inappropriate metadata, see detailed comments available in a free text item). The content of the database is outlined in Table 1, which provides additional information on each field of the data table. Upon data extraction, each record was checked by the data collectors and the content and integrity of the whole database was checked by two individuals prior to uploading the first version, called SquamEWL, in a public repository available at DOI: 10.5281/zenodo.3666172 (Le Galliard *et al.*, 2020). Routines for data extraction, database integrity check and data cleaning were coded in the R statistical language, and are briefly described below. The fully annotated code written for R version 3.6.3 (R Core Team, 2020) is also available in the public repository and includes functions to convert records between measurement scales.

246 3. Preliminary analyses

247 The SquamEWL dataset includes 2536 water loss records of 325 species and sub-species (301
248 unique species) of squamate reptiles for 793 unique samples (mean number of individuals per
249 sample = 10.15 ± 11.5 SD, median = 6, range=1-169) with most measurements obtained for TEWL
250 (N = 2146) and substantially fewer for CWL (264) and RWL (126). The vast majority of records is
251 from field-captured animals (N = 2015) in comparison to laboratory acclimated animals or those
252 raised in outdoor enclosures (N = 203). There is substantial variation in the acclimation time of
253 animals (time spent in the laboratory prior to measurement), even after excluding laboratory-raised
254 animals (range=0-750 days, mean = 46.45 ± 119.4 SD, median = 7). The predominant protocol
255 involves measurements of body mass loss in the laboratory (N = 1391), followed by direct
256 measurements of water vapor changes in flow-through chambers (N = 760), measurements of the
257 mass increase of a desiccant (N = 296), doubly-labeled water techniques in active animals (N = 56)
258 and, in more recent studies, flux chamber protocols for measurements of trans-epidermal water loss
259 (N = 33). The variation in micro-climatic environmental conditions during sampling is wide with air
260 temperatures ranging from 5.3 to 45°C (mean = 28 ± 6.47 SD, median = 27), VPD in the air ranging
261 from ca. zero to 9.10 kPa (mean = 2.83 ± 1.73 SD, median = 2.53) and air flow ranging from zero to
262 several hundred mL per min (mean = 146.5 ± 267.8 SD, about half of the records were obtained in
263 still air).

264 The geographic origin is available for 1923 records comprising 316 unique localities (Figure
265 2A) predominantly located in Northern and Central America, Europe and Australia, with under-
266 representation in pan-tropical diversity hotspots including South America, Africa and Asia as well
267 as several semi-arid and arid regions of Africa, the Arabian Peninsula and remaining Asia sub-
268 tropical regions (Roll *et al.*, 2017). The altitudinal range varied from sea level up to 3,718 m above
269 sea level with most records below 500 m (mean = 367.7 m, median = 74 m), which reflects the

270 prevalent altitudinal range for Squamata (Buckley *et al.*, 2008, 2012). The dataset contains
271 representatives of 34 families but only 2.71 % of the total species richness estimated for squamates.
272 Given the contribution of different families to the total species richness of squamate reptiles
273 worldwide (Uetz & Etzold, 1996; Roll *et al.*, 2017), there is an “over-representation” of species
274 from Lacertidae, Phrynosomatidae, Teiidae, Diplodactylidae, Sphaerodactylidae and Viperidae and
275 an “under-representation” of species from Gekkonidae, Gymnophthalmidae, Elapidae, Scincidae
276 and Colubridae (Figure 2B).

277 In addition to heterogeneity in sampling, measurements conditions and laboratory methods,
278 calculations of water loss rates vary among studies. In particular, EWL rates are reported on three
279 different scales, namely as mass-relative values (% of initial body mass or mg per g per hour, 1544
280 records), absolute values (mg water per hour, 715 records), or surface-relative values (mg per cm²
281 per hour, 270 records). To convert all EWL records to a single scale (mg per hour), we gathered
282 records reported for the same samples under the same conditions on different scales and used a
283 statistical procedure to fit a calibration function to convert data from relative to absolute scale (see
284 Supplementary File 1). Using this approach, we calculated 1884 unique estimates of absolute EWL
285 rates, including TEWL, CWL and RWL components. Preliminary non-phylogenetic analyses
286 indicated that TEWL and CWL rates scale allometrically with body mass with an exponent of ca.
287 0.6-0.7 (linear regression on a log-log scale, TEWL: slope = 0.66 ± 0.0154 SE, CWL: slope = 0.59
288 ± 0.048 SE; see Figure 2C), which is close to the 2/3 allometric exponent for the geometric
289 increment of surface area with the increment in body mass. The RWL component is generally
290 smaller than CWL component of TEWL in small-sized species and increases faster with body mass
291 (linear regression on a log-log scale, RWL: slope = 0.88 ± 0.058 SE), as expected from the 3/4
292 allometric exponent relating ventilation and metabolic rates to body mass. After correction for body
293 mass but not for experimental conditions, records of TEWL showed no clear altitudinal cline across
294 all samples (linear regression with log-transformed WL and mass, $F_{1,959} = 0.56$, $P = 0.09$), but a

295 small negative latitudinal cline (linear regression with log-transformed WL and mass, $F_{1,960} = 5.25$, P
296 $= 0.02$). Future analyses should explore more in depth the effects of species characteristics and
297 environmental conditions (e.g., temperature and humidity, habitat aridity) on inter-specific variation
298 in EWL.

299 Physical equations of TEWL require additional information on the temperature of the
300 animals, the body shape and air velocity, and the metabolism (see above). Surface ($N = 90$) and
301 body ($N = 190$) temperatures were very rarely reported because they are usually difficult to measure
302 and it is often assumed that they are at equilibrium with air temperature, which is not true in general
303 (Warburg, 1965). Air velocity could be calculated for most records ($N = 2204$) and ranged from
304 zero to 0.017 m per second (mean $= 0.0014 \pm 0.0029$ SD). We extracted 394 usable metabolic data
305 values from the same sources as in SquamEWL database including 105 unique species and
306 subspecies from 184 samples, which we present in a separate companion dataset. Notwithstanding
307 that, we provide the necessary functions to merge these data with those of the SquamEWL for users
308 potentially interested in mechanistic modeling of CWL and RWL using the NicheMapR software
309 (Pirtle *et al.*, 2019).

310 **4. Conclusion and perspectives**

311 The present dataset greatly expands previous compilations of EWL in squamate reptiles by nearly
312 doubling the number of species (ca. 100 species in Mautz, 1982; 139 species in Cox & Cox, 2015)
313 It also provides exhaustive metadata about methods, contexts and protocols in which each unique
314 data point was obtained. This expanded and fully annotated dataset will ease transparent and
315 reproducible statistical manipulation of EWL data for future studies, allow to examine how much
316 variation in EWL is caused by methodological factors instead of ecological or evolutionary drivers,
317 facilitate the estimation of skin resistance for an expanded list of species and will therefore ease
318 comparative analyses of EWL. The dataset may also assist in estimates of TEWL, CWL and RWL,

319 the conversion between different measurement scales and the identification of records performed
320 within pre-defined set of conditions such as standard records with non-manipulated animals at rest.
321 This is particularly important given the substantial differences in methodology among studies and
322 the inherent variability in EWL values caused by air temperature, air humidity and air velocity
323 during measurements. Potential case studies will include methodological analyses of microclimatic
324 factors such as temperature and humidity, partitioning of intra- and inter-specific variation and
325 comparative phylogenetic analyses of the diversification and environmental constraints on EWL
326 across species.

327 Despite earlier suggestions to better standardize EWL measurement protocols (Mautz,
328 1982), the current data covers a broad range of methods and contexts, and we found it difficult to
329 suggest an optimal and unique way to measure EWL in squamate reptiles because the exact protocol
330 will always depend on the specific research questions. Obviously, broad-scale comparisons of EWL
331 in poorly explored taxa and geographic areas would benefit from the use of simple approaches
332 where water loss is measured with a gravimetric method on animals at rest during a few hours in
333 controlled conditions in a ventilated box (Garcia-Porta *et al.*, 2019). On the other hand, functional
334 studies will require detailed quantification of the processes and patterns of water loss and therefore
335 continuous-time gas measurements following standard guidelines on animals at rest in controlled
336 conditions in flow-through chambers (Lighton, 2018).

337 We hope that the compiled metadata information of our database (see Figure 1B) will foster
338 the improvement of data reporting standards. In particular, we recommend that future studies of
339 EWL in squamate reptiles report systematically details of animal origin, husbandry conditions
340 before measurements, protocols and measurements conditions, and provide central tendencies and
341 dispersion statistics on absolute scales (mg per hour) or supply the raw data. We also hope to
342 stimulate future researchers to collect and report all the variables necessary to quantify skin
343 resistance to water loss R_s , a potentially central metric to mechanistic modeling approaches (Riddell

344 *et al.*, 2017). For example, macro-ecological studies may focus on spatial analyses of how climatic
345 and other abiotic aspects of the habitat interact to determine species distributions and their
346 vulnerability to environmental disturbances.

347 Our dataset further identifies critical geographic and taxonomic gaps that may be valuable in
348 guiding future investigations. The limited geographic and poor taxonomic coverage of our dataset
349 reflect known gaps in herpetological and ecological research (Roll *et al.*, 2017; Meiri, 2018; Etard
350 *et al.*, 2020). Such gaps and biases are also not surprising for functional traits related to physiology
351 for which coverage is much lower than ecological, life history, and morphological traits (> 20%
352 species coverage according to Etard *et al.*, 2020). Given that the water balance physiology of
353 squamate reptiles has been far less investigated than their thermal biology, we sustain that it is
354 crucial that a gap-filling effort be directed to the sampling of more data in undersampled areas and
355 taxonomic groups. More specifically, we shall mention the scarcity of data for Gekkonidae,
356 Scincidae and Colubridae on a taxonomical basis, and, from areas in South America, Africa and
357 Asia. The database will be regularly updated with these new data to provide a central resource for
358 ecological and evolutionary research on this particular animal group.

359 **Data Accessibility**

360 Data are available on the Global Ecology and Biogeography webpage and on Zenodo (doi:
361 10.5281/zenodo.3666172).

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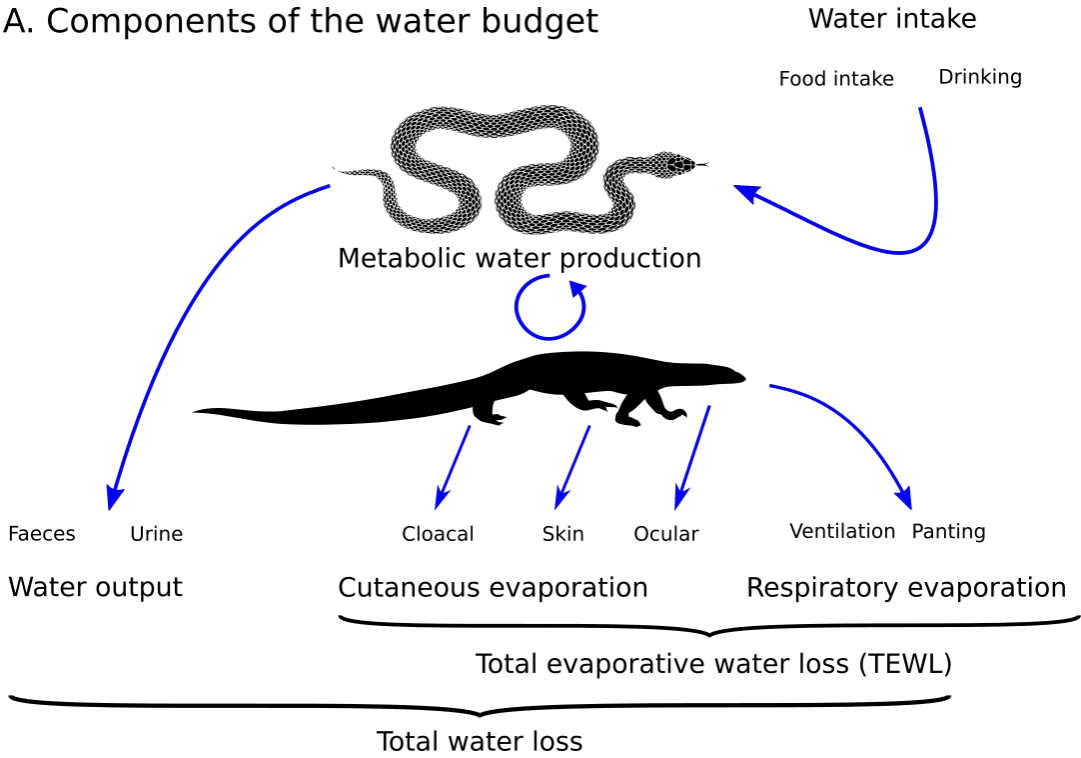
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363 **Figure legends**

364 **Figure 1.** Components of water loss in squamate reptiles and metadata required to describe evaporative
365 water loss (EWL). A. The total water budget of the animal rests on balance between water intake from food
366 and drinking of rain, free standing water or moisture, metabolic water production and water loss from
367 respiratory evaporation (RWL), water loss from skin, ocular or cloacal evaporation (CWL) and water loss
368 from feces and excreta. Total evaporative water loss (TEWL) is the sum of total respiratory and cutaneous
369 evaporative water loss and can be measured from post-absorptive animals in controlled laboratory conditions
370 provided they do not produce feces or excreta. B. Controlled description of EWL rates data using metadata
371 describing properties of entities (observations, including species, population and animals), observations
372 (including characteristics, protocols and context) and values. A rich metadata set is especially needed to
373 describe the methodology and the environmental conditions when EWL was measured. Each concept in this
374 figure refers to one or several columns of metadata in our database (see Table 1 for details). The database
375 was linked with associated data on metabolic rate (MR) whenever the study reported concurrent estimates of
376 MR for the same animals.

377 **Figure 2.** A. Geographic distribution of data records with exact coordinates of sampling location when
378 available. The geographic location of data records is mapped over a raster map of the Global Aridity Index
379 (GAI) for the 1970-2000 period (Trabucco & Zomer, 2019). The aridity index represents the ratio between
380 rainfall and a measure of potential evapo-transpiration (hyper-arid: $GAI < 0.03$; arid: $GAI < 0.2$; semi-arid:
381 $0.2 < GAI < 0.5$; dry sub-humid: $0.5 < GAI < 0.65$; humid: $GAI > 0.65$; the scale includes a larger range of
382 humid conditions for the sake of visualization). B. Phylogenetic tree of the Squamata according to a recent
383 time-calibrated phylogeny by (Zheng & Wiens, 2016). We calculated the proportion of species sampled
384 (black portion of each barplot) according to the Reptile Database (Uetz & Etzold, 1996) and the total number
385 of records for each family. Data deficient families are highlighted in blue. C. Allometric scaling of water loss
386 rates (mg water loss per hour) with body mass in 1485 records across 305 species for which TEWL, total
387 CWL and total RWL could be calculated. All individual data points are displayed on a log-log scale together
388 with the best linear non-phylogenetic regression line for each EWL component.

A. Components of the water budget



B. Controlled description of EWL

