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Descriptive and functional wetland typology and classification

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ABSTRACT

After a brief revision of the wetlands' typologies most used in Spain and taking into account that many concepts overlap others, a new descriptive and functional classification and typology of wetlands is offered in this paper based on the neologism «hygrochore» and other words derived from Greek roots. It is intended to unify criteria for a better and wiser use of the wetlands' terms.

RESUMEN

Tras una breve revisión de algunas de las tipologías sobre humedales más utilizadas en España en las que se solapan numerosos vocablos, se propone en este trabajo una clasificación y ulterior tipología descriptiva y funcional sobre la base del neologismo «higrocora» combinado con otras palabras derivadas de raíces griegas. Se pretende con ello unificar criterios para un uso más racional de la terminología sobre humedales.

From the very beginning of my interest on wetlands, I came to the feeling that there was no unified classification, so that I started to work it out. This task was so time consuming that classification completely absorbed my mind for long periods of time, whose results may be exposed in this paper.

INTRODUCTION

At first sight, wetlands are areas of the earth surface showing water generated conditions. So it is my very initial interest to emphasise upon the spatial extent of these terrains. But, as every elementary words, «land» and «wet» must be further defined to be caught in a scientific expression. In other languages like French (zones humides), Spanish (humedales), German (Feuchtgebiete), Latin (regio) or Greek (*χώρα*) [1], the words chosen to describe this concept have geographical connotations. Wetness is also quite difficult to be delimited. Etymologically cognate to water, it describes the soaking, moistening, saturating or water containing condition of the land. This special property is evident in two ways: (i) the sufficiently visible perception of shallow water covering the topographic surface; (ii) the occurrence of geomorphic, vegetational, pedological, zoological, ecological and landscape (including man-made) features with clear hydromorphism and sharp hygromorphism. This second approach needs the help of an expertise or trained person to assess the extent to which environmental indicators of moisture are present.

According to the big complexity of nature in environments, since the second half of the 19th century different components of the landscape have been recognised. These components interact and combine together to explain the physiology of a genuine land (often told landscape or geosystem): (i) atmosphere, (ii) lithosphere, (iii) biosphere, and (iv) hydrosphere. Teilhard de Chardin added a fifth component, the noosphere introducing mankind as an explanation element within the landscape (or reality). From the coupling of hydrosphere and lithosphere a vast number of landscapes arise where wet conditions may be found, essentially coasts, and margins of lakes, rivers, snow patches and glaciers. Nevertheless it was not but recently that groundwater marginal wetlands were taken into account and accepted by the scientific community, mainly because of the arid and semiarid lands experience. The atmosphere becomes saturated or close to saturation values where high physical evaporation or biological transpiration rates are present. Only the lowest air layers can then get wet, closely related to water surfaces and exuberant vegetation. Plant and animal communities living on humid or waterlogged landscapes have been called hygromorphic and show accurate and specific organic and functional adaptations to water conditions. These features should be regarded as very ancient since life is supposed to begin and initially develop in the sea or in the muddy fringe of coas-

[1] *χώρα* = land (cf. chorology).

tal regions. Prehistoric man adapted to wetlands using palafittes as dwellings or crossing paludous swamps through timber-built paths, while these areas were considered highly unhealthily , and human societies moved apart from them.

Processes and «functionings» today stand out as the major scientific aims in every environmental discipline. For doing so the mentioned elements are put together in an order which wants to reflect the weighted importance of each component within the geosystem. In wetlands as in other geographical ecosystems most mass is due to the presence of the rock element, and mass goes down towards hydric, biotic and atmospheric components. If mass drops down, inertia is lowered in the same sense. Inertia is the way to measure the change capability and rate of a geosystem. The lithospheric component may occupy up to 95% of the whole mass of the ecosystem. It is then followed by water and by biotic element. The ecosystem atmosphere which also penetrates within the soil is so changeable that measured values of it may have no significant time scale. This fact makes it difficult to adjust the nearest elements together. Some good results may be achieved by reducing all components and elements to their common essence: matter and energy. Measuring difficulties arise when trying to monitor nature variables.

SOME CLASSIFICATINS OF WETLANDS

From the many essays on wetland types I have chosen only the most well-known in our land and scientific community.

(A) The Spanish wetland typology within the MEDWET Project was as follows:

1. COASTAL
    - 1.1. Coastal lagoons
    - 1.2. Deltas
    - 1.3. Marshes

2. INLAND
    - 2.1. Lakes
    - 2.2. Oases/Chotts/sebkhas
    - 2.3. Stepparian and endorheic complexes
    - 2.4. Springs and karstic
    - 2.5. Fluvial floodplains
    - 2.6. Peatland
    - 2.7. «Ramblas»/wadis

3. ARTIFICIAL
   3.1. Saltworks
   3.2. Sand and gravel pits
   3.3. Rice fields
   3.4. Aquaculture
   3.5. Restoration techniques

(B) Wetland Classification at the RAMSAR Conference

1. MARINE AND COASTAL
   1.1. Marine
      1.1.a. Marine shallow waters
      1.1.b. Marine beds
      1.1.c. Coral reefs
      1.1.d. Rocky coasts
      1.1.e. Sand and shingle beaches (including dune systems)

   1.2. Estuarine
      1.2.a. Estuarine waters
      1.2.b. Tidal plains (including intertidal and sandy plains)
      1.2.c. Salt marshes
      1.2.d. Mangrove/tidal forests

   1.3. Lacustrine/palustrine
      1.3.a. Coastal saline/brackish lagoons
      1.3.b. Coastal freshwater lagoons

2. INLAND
   2.1. Fluvial
      2.1.a. Deltas
      2.1.b. Permanent rivers/streams/creeks
      2.1.c. Intermittent rivers/streams/creeks

   2.2. Lacustrine
      2.2.a. Permanent freshwater lakes
      2.2.b. Seasonal/intermittent freshwater lakes
      2.2.c. Permanent saline/brackish lakes/marshes
      2.2.d. Seasonal/intermittent saline/brackish lakes/marshes

   2.3. Palustrine
      2.3.a. Permanent freshwater marshes/ponds
      2.3.b. Seasonal/intermittent freshwater marshes/ponds

- 2.3.c. Peatland (bogs, fens, forested)
- 2.3.d. Tundra/alpine wetlands
- 2.3.e. Shrub wetlands
- 2.3.f. Tree wetlands (including forested wetlands)
- 2.3.g. Freshwater springs (including oases)

2.4. Geothermal: Geothermal wetlands

3. ARTIFICIAL
   - 3.1. Aquaculture: fish, seafood ponds
   - 3.2. Agriculture:
     - 3.2.1. Irrigation ponds and pools
     - 3.2.2. Irrigated land (including rice fields)
     - 3.2.3. Seasonally flooded farmland
   - 3.3. Saltworks
   - 3.4. Urban and industrial
     - 3.4.a. Reservoirs, dams
     - 3.4.b. Sand and gravel pits, clay quarries
     - 3.4.c. Residue pond
     - 3.4.d. Canal

4. NO INFORMATION

(C) Codified wetland type system proposed for the MEDWET Project :

MARINE AND COASTAL:

Marine:

subtidal .... shallow marine waters
marine bed .... aquatic marine beds
reef .... coral reefs
intertidal rocky .... rocky marine coast
non consolidated .... sand/shingle beaches

Estuarine:

subtidal .... estuarine waters

intertidal non consolidated .... intertidal mud plains
emergent .... salt marshes
forested .... mangrove, intertidal forest

Lacustrine/ Palustrine :
permanent/seasonal .... brakish and saline coastal lagoons
.... freshwater coastal lagoons

INLAND:

Fluvial: permanent .... permanent rivers and streams
emergent .... inland deltas
intermittent .... intermittent rivers and streams
emergent .... floodplain wetlands

Lacustrine: permanent .... freshwater permanent lakes
seasonal .... freshwater seasonal lakes
permanent/seasonal .... permanent/seasonal salt lakes and marshes

Palustrine: permanent .... permanent freshwater ponds and marshes
emergent .... (acid) bogs and (alkaline) fens

Please notice that there is no unique criterion for displaying the classification and in most cases the decision tree is based on criteria jumping from position at the continent to water origin, water regime, water quality and others.

CLASSIFICATION CRITERIA AND FORMALITY

Based on the philosophy of the aforementioned ideas, wetlands classification was begun from the initial descriptive criteria such as size, position and form, continuing by more specific items such as geomorphology, hydrology, and vegetation. The resulting typology must be considered as an open one, which can undergo substantial improvements by successive approaches. Some new descriptors can be added, further classes can be searched as it was impossible to take account of all criteria we can think of. Giving names to the resulting classes has been an additional difficulty: after a variety of attempts, Greek rooted words were selected. Today's science is not very keen on such expressions, but ancient Greek was used because of its possibilities for translation into the most well-

INTEC CLASSIFICATION OF LAKES AND WETLANDS

INLAND

LAKES

Type	Basin's origin	Hydric regime	Hydrological type	Renovation rate Fluctuations	Water chemistry	Trophic state	Temparature regime
Glacial-karstic	Glacial and solutio	Mixed-closed	Groundwater	Medium-low	Alkaline Mineral Calcium hydrocarbonates	Oligotrophic	Dimictic
Glacial	Glacial	Open	Suface Run-off	Upper medium-medium	Alkaline neutral Very low mineral content	Oligo-mesotrophic	Dimictic
Karstic	Solution and collapse	Open	Groundwater	Medium-low	Alkaline Mineral Calcium hydrocarbonates Sulfate rich	Oligotrophic	Monomictic Meromictic
Tectonic	Tectonic and erosive	mixed	mixed	Medium-low	Neutral, hypodermic	mesotrophic	Monomictic

WETLANDS

Type	Basin’ origin	Hydric regime	Hydrological type	Ion concentration	*p*H	Transparency
Glacial-karstic	Glacial and solution	Permanent-half permanent	Surface run off	Medium	Alkaline	Clear
Glacial	Glacial	Permanent-half permanent	Surface run off	Very low	Acid-neutral	Clear
Karstic	Solution and collapse	Permanent-seasonal	Groundwater	Medium, brackish	Alkaline	Clear
Tectonic-strucural	Tectonic, erosion and sedimentacion	Mixed	Mixed	Medium, brackish	Neutral-acid	Clear-cloudy
«raña» and/or aeolian	Aeolian erosion	Seasonal	Groundwater Surface run off	Very low	Acid-neutral	Clear
Stepparian	Hydro-aeolian, Solution, Tectonic	Seasonal	Surface run off groundwater	Brackish to saline and brine	Neutral-alkaline	Clear-cloudy
Dune complexes	Aeolian	Permanent-seasonal	Groundwater	Very low	Neutral	Clear-cloudy
Floodplains	Hydric	Seasonal	Surface run off	Low-medium	Neutral	Cloudy
Regional groudwater run of	Hydric	Permanent-half permanent seasonal	Groundwater	Medium	Alkaline	Almost cloudy
Volcanic	Crater, erosion	Permanent-seasonal	Surface run off Groundwater	Medium, brackish	Alkaline	Cloudy
Artificial	Hydric	Seasonal	Surface run off	Low	Neutral-alkaline	Clear-cloudy
Peatland	Hydric	Permanent	Groundwater Surface run off	Low	Acid	Cloudy

COASTAL

MEDITERRANEAN WETLANDS

Type	Basin's origin	Hydric regime	Marine influence	Tectonic activity	Filling rate	Vegetation and others
Deltaic features	Fluvial deposition > Marine distribution	Surface run off Groundwater Sea water	Only at the coastal fringe-waves	Delta at subsidence place	High	Great environments' variety; vegetation rich, varied salinity, turf
Coastal lagons	Hydric erosion and sedimentaction	Surface run off Groundwater	Deficient and limited by the «eastern winds»	Estuary at rising coast	High	Barrier beach, varied environments, inlets, varied mineralization
«marjales»	Hydric erosion	Groundwater	None	Waterlogged area at raising coast	High	Hydrophytes, feshwater turf, thick barrier
Salrworks	Artificial	Sea water	High	Waterlogged area at raising coast	Man induced	High salinity, scarce vegetation, high environmengtal value

ATLANTIC WETLANDS

Type	Basin's origin	Hydric regime	Marine influence	Tectonic activity	Filling rate	Vegetation and others
Exposed coastal fronts	Marine erosion	Surface run off and marine water	Important tidal	Subsidence coast	Medium-low	Seaweeds, vertical accretion, educational value
Inland areas without barrier	Fluvial and marine erosion	Surface run off and marine water	Tidal Atlantic surges	Estuary at subsidence coast	Medium-low	Complex channel net, mud plains
Inland areas with barrier	Fluvial and marine erosion	Surface run off and marine water	Almost scarce Atlantic surges	Estuary at subsidence coast	Medium-high	Varied salinity and currents, presence of sand barrier
Atlantic marshes	Fluvial deposition and barrier building	Surface run off Groundwater Sea water	Considerable	Fluvial mouth at raising coast	High	Sabd systems, *Salicornia* and other salt species, sand spit

known languages. I must accept that it is quite stupid to create neologisms when other words are utilised by the common scientific community. It is also nonsense to try long composed words to be competitive with short English expressions. Among the languages I know English shows the highest ability to comprehensively describe complex thoughts. As an example, let me explain the connotations of a fen: shallow water or saturated soil land which has alkaline reaction. Other examples could be bog, mire, peat, and so forth. But even so translation problems may arise when these short three-sounds expressions have to be put into other languages. I would propose the word **hygrochore**[2] instead of wetland, as it is the best Greek expression. I have in mind that in modern Greek, the word chosen to translate the English wetland is hygrotopos (topos = location), but the regional or extension idea is best reflected by the neologism I propose. Most wetlands researchers from Greece have agreed with my proposal.

1. GENERAL DESCRIPTION

1.1. Size

Size is the first term to be included in a classification of an extensive area object. The square meter (m^2) is the universally accepted unit of surface area. It was created during the French Revolution when the goddess Reason was set in the throne. Thus on the basis of square meter, prefixes have been used to express multiples. Most of the wetlands have sizes of hecto- and mega-square meters.

1.1.1.	monohygrochores[3]	$10^0 = 1\ m^2 = 1$ ca
1.1.2.	decahygrochore[4]	$10^1 = 10\ m^2 = 1$ da
1.1.3.	hectohygrochore[5]	$10^2 = 100\ m^2 = 1$ a
1.1.4.	kilohygrochore[6]	$10^3 = 1{,}000\ m^2 = 1$ Da
1.1.5.	myriahygrochore[7]	$10^4 = 10{,}000\ m^2 = 1$ Ha
1.1.6.	megahygrochore[8]	$10^6 = 1{,}000{,}000\ m^2 = 1\ km^2$
1.1.7.	gigahygrochore[9]	$10^9 = 1{,}000\ km^2$
1.1.8.	terahygrochore[10]	$10^{12} = 1{,}000{,}000\ km^2$

[2] *ὑγρός* = wet, humid; *χώρα* = land.
[3] *μόνος* = one, unique (cf. monospecific).
[4] *δέκα* = ten (cf. decathlon).
[5] *ἥκατον* = hundred (cf. hecatombe).
[6] *χίλιοι* = thousand (cf. kilogram).
[7] *μυρίος* = ten thousand (cf. myriad).
[8] *μέγας* = big (cf. megastructure).
[9] *γίγας* = giant (cf. gigabyte).
[10] *τέρας* = big animal, monster (cf. terabyte).

1.2. Length-width ratio and form

After having faced the areal dimensions of wetlands, form and length-width ratio can be introduced to focus upon further description. It is assumed that some of the forms adopted by hygrochores relate to their origin and functioning. For instance, cyclohygrochores are most usually found in karstic zones where solution potholes occur. Irregular-shaped amoebohygrochores are present where hydroaeolic flat depressions exist. Hooked oncohygrochores can be remnants of ox-bow lakes. Tainohygrochores prevail where linear erosion is dominant, like in fluvial one-channel processes. Aeolian action over the thaw lakes in high latitude wetlands results in lemniscohygrochores (string bogs),...

1.2.1.	tainohygrochore [11]	stripped, $L >> l$ (L = length; l = width)
1.2.2.	brachyohygrochore [12]	wide, almost isodimensional, $L \simeq l$
1.2.3.	cyclohygrochore [13]	rounded
1.2.4.	elliptohygrochore [14]	elliptic
1.2.5.	ophiohygrochore [15]	snake-like
1.2.6.	oncohygrochore [16]	hooked
1.2.7.	lobohygrochore [17]	lobed, lobular
1.2.8.	amoebohygrochore [18]	irregular, shape changing
1.2.9.	deltahygrochore [19]	deltoid, with three well defined edges
1.2.10.	lemniscohygrochore [20]	lemniscate-like

1.3. Depth

Maximum depth accepted to water covering wetlands is six meters, according to the Ramsar definition. Therefore if depth is less / more than 3 meters, two classes arise.

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[11] *ταινία* = strip.
[12] *βραχύς* = wide, short (cf. brachysyncline).
[13] *κύκλος* = wheel (cf. cycle).
[14] *ἐλλειπτικός* = elliptic.
[15] *ὀφίς* = snake (cf. ophite).
[16] *ὄγκος* = hook (cf. oncology).
[17] *λοβός* = lobe.
[18] *ἀμοιβή* = change (cf. amoeba).
[19] *δέλτα* = delta, Greek letter (cf. deltaic).
[20] *λημνίσκος* = strips surrounding a crown (cf. lemniscate).

1.3.1. bathohygrochore [21] deep, > 3 m
1.3.2. abathohygrochore [22] shallow, < 3 m [23]

More advanced classes can be achieved if a similar typology to that described as hydroperiod or xeroperiod is taken into account.

1.4. Position

Geographical location is first related to longitude, latitude and altitude. But it is even more important in our case to consider the distance to the sea, and separate continental from coastal and sea fringe wetlands.

Thus three categories of wetlands may be used:

1.4.1.1. epeirohygrochore [24] continental
1.4.1.2. thalassohygrochore [25] maritime, mainly influenced by the ocean and active sea nearby
1.4.1.3. paraliohygrochore [26] coastal, with a more intensive influence of continental processes

In accordance with latitude, torrid, warm, changing, cool and cold zones may be distinguished. In such a manner,

1.4.2.1. thalpohygrochore [27] torrid, hot
1.4.2.2. thermohygrochore [28] warm
1.4.2.3. tropohygrochore [29] changing, variable temperature
1.4.2.4. psycrohygrochore [30] cool
1.4.2.5. cryerohygrochore [31] cold

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[21] *βαφύς* = deep (cf. batholite).
[22] *ἀβαφύς* = shallow.
[23] In modern Greek the word shallow is translated by *ρηχός*, but it was not used in the classic reference language.
[24] *ἤπειρος* = continent, land as opposite to sea (cf. epirogenic).
[25] *φάλασσα* = sea (cf. thalasotherapy).
[26] *παράλιος* = coastal, maritime.
[27] *θάλπος* = heat (cf. enthalpy).
[28] *θερμός* = warm, hot (cf. thermometer) .
[29] *τροπή* = turn, change (cf. Tropics).
[30] *ψυχρός* = cool (cf. psychrometer).
[31] *κρύερος* = cold, gelid (cf. cryosphere).

Wetlands can also occupy different height positions, from lowlands to summits.

1.4.3.1. coilohygrochore [32] hollows
1.4.3.2. pediohygrochore [33] lowlands, plains
1.4.3.3. orohygrochore [34] highlands
1.4.3.4. acrohygrochore [35] peaks
1.4.3.5. stromatohygrochore [36] levelled, blanket

Raised bogs in hyperhumid regions of the world perfectly fit into acrohygrochores (German *Hochmoor*), and bog or fen (*Niedermoor*) can be described as coilohygrochores. The Irish blanket bogs would be called stromatohygrochores.

1.5. Sociability

When we look at and interpret a topographical map, wetlands can appear as unique or isolated spots, or they can occur as sets which otherwise can be organised or chaotic.

1.5.1. nesohygrochore [37] isolated, island-like
1.5.2. ochlahygrochore [38] resembling a population, set

1.5.2.1. chaohygrochore [39] chaotic
1.5.2.2. taxohygrochore [40] patterned

1.5.2.2.1. zeugohygrochore [41] coupled
1.5.2.2.2. desmohygrochore [42] chain
1.5.2.2.3. tagmohygrochore [43] net-like

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[32] *κοῖλος* = empty.
[33] *πεδίον* = plain.
[34] *ὄρος* = mountain (cf. orographic).
[35] *ἄκρος* = acute, sharp, high (cf. acrobat).
[36] *στρῶμα*, -*ατος* = blanket (cf. stromatolith).
[37] *νῆσος* = island (cf. nesosilicates).
[38] *ὀχλός* = crowd.
[39] *χάος* = chaos (cf. chaotic).
[40] *τάξις* = order, unit (cf. taxon).
[41] *ζέυγος* = yoke, ox bow (cf. syzygy).
[42] *δεσμός* = chain.
[43] *τάγμα* = legion, company.

2. GEOMORPHOLOGY

The landforms must be considered as a complex relation between lithology and sculpting processes at the earth surface. It is therefore important to know the genetic role played by the landforming agents :

2.1. Origin

2.1.1. Exogenous

2.1.1.1. aeolohygrochore [44] wind
2.1.1.2. hydroaeolohygrochore [45] hydroaeolian origin
2.1.1.3. potamohygrochore [46] water stream
2.1.1.4. limnohygrochore [47] lake
2.1.1.5. organohygrochore [48] organisms
2.1.1.6. hialohygrochore [49]sea
2.1.1.7. meteoritohygrochore [50] meteorite
2.1.1.8. barohygrochore [51] gravity
2.1.1.9. pagetohygrochore [52]glaciers
2.1.1.10. nifadohygrochore [53] snow
2.1.1.11. saprolithohygrochore [54] (deep and intense) weathering
2.1.1.12. pegehygrochore [55] water spring
2.1.1.13. solenohygrochore [56]piping or tunnelling
2.1.1.14. stasipagohygrochore [57]stagnant ice
2.1.1.15. sphenopagohygrochore [58] ice wedging
2.1.1.16. pagolaccohygrochore [59] pingo
2.1.1.17. texehygrochore [60] ice melting, general thaw (although sometimes called thermokarstic)

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[44] *'Αίολος* = Aeolus, Greek god of wind (aeolian).
[45] *ὕδωρ, ὑδάτος* = water; *'Αίολος* = wind.
[46] *πόταμος* = river (cf. hippopotamus).
[47] *λίμνη* = lake (cf. limnology).
[48] *ὄργανον* = organ.
[49] *ἱαλός* = sea (cf. hyaloclastites).
[50] *μετεωρίτης* = meteorite.
[51] *βάρος* = weight (cf. barometer).
[52] *παγετός* = glacier.
[53] *νιφάς, νιφάδος* = snow.
[54] *σαπρός* = rotten; = *λίθος* = stone (cf. sapropel).
[55] *πηγή* = spring.
[56] *σωλήν, σωλήνος* = pipe, tube (cf. solenoid).
[57] *στασιμός* = stagnant; *πάγος* = ice.
[58] *σφήν* = wedge; *πάγος* = ice (cf. sphenoschasm).
[59] *πάγος* = ice; *λάκκος* = cave.
[60] *τήξη* = melting, thaw.

2.1.2. Endogenous

2.1.2.1. karstohygrochore [61] karstic, hypogenic
2.1.2.2. pseudokarstohygrochore [62] gypsum karst
2.1.2.3. cryptokarstohygrochore [63] covered karst
2.1.2.4. hadohygrochore [64] volcanic
2.1.2.5. craterohygrochore [65] crater
2.1.2.6. taphrohygrochore [66] in a geologic graben
2.1.2.7. hemitaphrohygrochore [67] in a geologic semigraben
2.1.2.8. regmahygrochore [68] fault or fault line
2.1.2.9. ptychohygrochore [69] in a fold

2.1.2.9.1. synclinohygrochore [70] in a syncline
2.1.2.9.2. anticlinohygrochore [71] in an anticline

2.1.2.10. poikilolithohygrochore [72] lithological contact (varied lithology)

2.2. Geomorphic process type

In all cases wetlands can be generated by erosion (denudation) or aggradation processes.

2.2.1. ectrogohygrochore [73] erosive processes
2.2.2. phragmahygrochore [74] construction of a barrier

2.2.2.1. lavaphragmahygrochore [75] lava barrier
2.2.2.2. castorphragmahygrochore [76] beaver-built

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[61] Karst = Croatian, Slovenian region where solution features on carbonatic rocks were first described.
[62] *ψεῦδος* = lie, error (cf. pseudonymous).
[63] *κρυπτός* = hidden (cf. cryptogram).
[64] *Ἅιδης* = Haedes, Greek god of the earth interior.
[65] *κρατήρ* = crater, cup.
[66] *ταφρός* = grave (cf. taphrogeny).
[67] *ἡμί* = half; *ταφρός* = grave.
[68] *ῥῆγμα* = fissure (cf. rhegmatic field).
[69] *πτύχη* = fold.
[70] *σὺν* = with; *κλίνειν* = to be inclined (cf. syncline).
[71] *ἀντὶ* = against; *κλίνειν* = to be inclined (cf. anticline).
[72] *ποικίλος* = varied, mottled; *λίθος* = stone (cf. poikilotherm).
[73] *ἐκτρώγειν* = to devour, to eat up.
[74] *φράγμα* = barrier (cf. Phragmites).
[75] *λάβα* = lava.
[76] *κάστωρ* = beaver.

2.2.2.3. pagaphragmahygrochore[77] ice barrier
2.2.2.4. thinophragmahygrochore[78] dunes

2.3. Sediments

The presence of different types of sediments should not be ignored. At least five characteristic sediment textures might be introduced.

2.3.1. pelohygrochore[79] clay
2.3.2. ilyhygrochore[80] silt
2.3.3. psammohygrochore[81] sand
2.3.4. psephohygrochore[82] coarse sized sediments
2.3.5. borborohygrochore[83] organic, usually stinking or fetid mud or loam

2.4. Process activity

Geomorphic process activity is always low when considered against other processes, and the original conditions may have changed towards other functional ones.

2.4.1. palaeohygrochore[84] ancient, relict processes
2.4.2. lathohygrochore[85] latent processes
2.4.3. drahygrochore[86] active processes

3. CLIMATE

The temperature regime of a wetland is always retarded when it is compared to non-saturated surrounding lands. But temperature annual amplitude (aA) and daily oscillation (dO) can be chosen as a criterion for wetland classification:

[77] *πάγος* = ice.
[78] *θίς, θινός* = dune, sand mountain.
[79] *πηλός* = clay, loam (cf. sapropel, pelitic).
[80] *ἰλύς* = silt.
[81] *ψάμμος* = sand (cf. psammophyte).
[82] *ψήφος* = gravel, cobble (cf. psephite).
[83] *βόρβορος* = mud, loam.
[84] *παλαίος* = old, ancient (cf. palaeolithic).
[85] *λανθάνειν* = to hide, to hold latent.
[86] *δράειν* = to act, to be active.

3.1. thermoclimatohygrochore [87] if aA < dO
3.2. tropoclimatohygrochore [88] aA ≈ dO
3.3. mesoclimatohygrochore [89] aA > dO
3.4. chimoclimatohygrochore [90] aA >> dO
3.5. cryoclimatohygrochore [91] frost conditions almost all the year

4. HYDROLOGY

The hydric component of wetlands is so important in defining functional and genetic values of wetlands that it ought to be regarded in a more detailed way.

4.1. Water origin

According to the water origin criterion, wetlands can be classified into the following types:

4.1.1. ombrohygrochore [92] direct rainfall
4.1.2. ceraunohygrochore [93] big or heavy storms supply most of the filling water
4.1.3. exorheohygrochore [94] surface runoff, streams
4.1.4. hypodermohygrochore [95] interflow, soil lateral inflow
4.1.5. pelagohygrochore [96] sea water
4.1.6. phreatohygrochore [97] groundwater

If a further typology wants to be considered in groundwater studies, local, long and median distance flows are recognised using available total dissolved solids (TDS) or electrical conductivity (EC) data.

4.1.6.1. engifreatohygrochore [98] local supply

[87] *θερμός* = hot, warm; *κλίμα, κλίματος* = inclination, climate .
[88] *τροπή* = change.
[89] *μέσος* = median.
[90] *χειμών* = winter.
[91] *κρύος* = ice, frost.
[92] *ὄμβρος* = rain (cf. ombrothermic).
[93] *κεραυνός* = storm, lightning (cf. isocheraunic level).
[94] *ἐξ* = out ; *ῥεῖν* = to flow.
[95] *ὑπὸ* = under; *δέρμα* = skin (cf. hypodermic).
[96] *πέλαγος* = sea.
[97] *φρέαρ, φρέατος* = well (cf. phreatic level).
[98] *ἐγγύς* = near; *φρέαρ* = well.

4.1.6.2. mesofretohygrochore [99] median transport
4.1.6.3. telefreatohygrochore [100] long distance flow

4.2. Water movement

Within the unsaturated zone water filling the soil pores may come through three pathways:

4.2.1. catarheohygrochore [101] from above
4.2.2. pleurarheohygrochore [102] by lateral movement
4.2.3. anarheohygrochore [103] ascending by capillarity

4.3. Duration of the hydroperiod

It is possible to classify the hydrology of wetlands according to the duration of the hydroperiod (period with water coverage) or the xeroperiod, and one has to be sure to introduce both categories into the model as , at least, two different types of wetlands —atlantic and arid— can be studied. In most cases the water regime within the soil is unknown, but it would be necessary to start data collection immediately to be able to get long term series of almost 30 years (the same as in climatic rainfall series) , which really could be representative for the mean soil moisture content.

4.3.1. euhygrochore [104] atlantic, humid type
4.3.2. xerohygrochore [105] arid type

In the xerohygrochores the extent of the hydroperiod is most significant. Thus a logarithmic scale can be used:

4.3.1.1. eoxerohygrochore [106] 12-6 months lasting hydroperiod
4.3.1.2. oligoxerohygrochore [107] 6-3 months hydroperiod
4.3.1.3. mioxerohygrochore [108] 3-1.5 months hydroperiod

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[99] *μέσος* = median.
[100] *τῆλε* = far, distant (cf. television).
[101] *κατά* = down; *ῥεῖν* = to flow.
[102] *πλευρά* = side, flank (cf. pleuropneumonia).
[103] *ἀνά* = up (cf. analysis).
[104] *εὖ*= right, well (cf. european).
[105] *ξηρός* = dry, arid (cf. xeromorphic).
[106] *ἕως* = dawn (cf. Eocene).
[107] *ὀλίγος* = poor, little (cf. oligofrenic).
[108] *μείων* = less (cf. Miocene).

4.3.1.4. plioxerohygrochore[109] 45-23 days hydroperiod
4.3.1.5. pleistoxerohygrochore[110] 23-12 days hydroperiod
4.3.1.6. holoxerohygrochore[111] < 11 days hydroperiod

4.4. Water quality

Water quality seems a very important element for the understanding of most of the wetlands processes. In order to assume this information, major ions have to be considered. These ions are listed as anions and cations, so that different combinations are possible.

4.4.1. anions

4.4.1.1. carbonates
4.4.1.2. hydrocarbonates
4.4.1.3. chlorides
4.4.1.4. sulfides
4.4.1.5. sulfates
4.4.1.6. sulfites
4.4.1.7. fluorides
4.4.1.8. bromides
4.4.1.9. nitrates
4.4.1.10. nitrites
4.4.1.11. silicates

4.4.2. cations

4.4.2.1. calcium
4.4.2.2. sodium
4.4.2.3. magnesium
4.4.2.4. iron
4.4.2.5. lithium

As an alternative to this very long classification others have been proposed.

4.4.0.1. glycohygrochore[112] freshwater fed; TSD < 1000 ppm
4.4.0.2. halohygrochore[113] salty water TSD > 1000 ppm

[109] *πλείων* = more (cf. Pliocene).
[110] *πλεῖστος* = the most (cf. Pleistocene).
[111] *ὅλος* = whole, total (cf. holographic).
[112] *γλυκύς* = sweet (cf. glucose).
[113] *ἅλς* = salt (cf. halophyte).

4.4.0.2.1. oligohalohygrochore [114] 1000 <TSD<10000
4.4.0.2.2. mesohalohygrochore [115] 10000<TSD<20000 brackish
4.4.0.2.3. hyperhalohygrochore [116] 20000<TSD<35000 saline
4.4.0.2.4. polihalohygrochore [117] TSD > 35000 ppm brine

4.5. Functional analysis

Wetlands may function as sources, transporters and sinkholes of nutrients, ions and chemical components.

4.5.1. ekhygrochores [118] function as a fountain
4.5.2. diahygrochores [119] just transport
4.5.3. enhygrochores [120] can eat up different components

This analysis can further be applied to the material or ion which is movable. So, some of the Spanish wetlands we have studied show quite different behaviours during the seasonal rhythm: in summer they act as ensulfatehygrochores, in winter they comport as eksulfatehygrochores, but during the equinoctial seasons sulfates are washed through (diasulfatehygrochores).

4.6. Flooding conditions

In many cases wetlands receive huge water quantities because of extreme events , either catastrophic or seasonal. Monsoonal floodings is a good example for the conditions we want now to point out. It might be often, rarely, water coming from the sea according to the tidal movement, or when overland flow increases water discharge of streams and these come out of their channel.

4.6.1. Flooding frequency

4.6.1.1. spanihygrochore [121] rarely
4.6.1.2. sychnohygrochore [122] often

[114] *ὀλίγος* = poor, little .
[115] *μέσος* = median.
[116] *ὑπέρ* = over.
[117] *πολύς* = all.
[118] *ἐκ* = out.
[119] *διά* = trough.
[120] *ἐν* = in.
[121] *σπάνιος* = rare.
[122] *συχνός* = frequent.

It is even possible to continue classifying on a numerical frequency basis.

4.6.2. Flooding origin

4.6.2.1. palirrohygrochore [123] tides
4.6.2.2. epiklyzohygrochore [124] continental flooding
4.6.2.3. migmahygrochore [125] mixing conditions

5. SOILS

It is well-known that wetland soils show very typical reducing conditions. But according to the different soil taxonomies, and classifications (FAO, ST, England and Wales Soil Survey, Russian , German, French classifications ...) it is not easy to include long words to compose or construct a sausage-like term. We propose to identify either reducing or oxidising conditions within the soil as a proof of its water balancing regime and to add the name of the soil taxon whatever classification might be used.

5.1. Redox conditions

5.1.1. oxidohygrochore [126] when oxidising conditions prevail, E*h*>+400 mV
5.1.2. aerobiohygrochore [127] clarified water present, +250mV<E*h*<+400 mV
5.1.3. anoxihygrochore [128] no oxygen content, -100 Mv < E*h*<+250 mV
5.1.4. anaerobiohygrochore [129] highly reducing conditions E*h*< -100 mV

As in other cases these classes can be more precisely captured by using a seasonal approach, that is, depending on the available data. In that sense it is possible to go beyond the already existing classes. All the redox potentials (E*h* in mV) have been given for *p*H 7.

5.2. *p*H values

In addition to redox potentials which show electrons transfer, *p*H reaction of the soil measures the protons transfer ability. Fens and bogs are put apart

[123] *παλίρροια* = tide.
[124] *ἐπικλίζειν* = to wash, to flood.
[125] *μίγμα* = mixture (cf. migmatite).
[126] *οξείδοση* = oxidising (Modern Greek).
[127] *ἀήρ* = air; *βίος* = life (cf. aerolith).
[128] *ἀν* = un- ; *ὀξύς* = sharp (cf. oxygen).
[129] *ἀν* = un- ; *ἀήρ* = air ; *βίος* = life.

using such a simple value. During the ordinary evolution of a fen towards a raised bog, *p*H changes from alkaline or neutral to highly acid conditions. Thus

5.2.1. holalkalohygrochore [130] *p*H values > 8.5
5.2.2. alkalohygrochore [131] 8.5 > *p*H > 6.5
5.2.3. oxohygrochore [132] 6.5 > *p*H > 4.5
5.2.4. holoxohygrochore [133] *p*H values < 4.5

5.3. Soil classifications

As an example of how words coupling soils to wetlands would look like, some of them are listed below:

5.3.1. aqualfhygrochore
aquenthygrochore
aquepthygrochore
aquollhygrochore
aquoxhygrochore
aquodhygrochore
aquulthygrochore
medisapristhygrochore
sulfohemisthygrochore
stagnogleyhygrochore
pelosolhygrochore
planosolhygrochore
pseudogleyhygrochore
solonchakhygrochore
solonetzhygrochore
solodhygrochore
chromic luvisolhygrochore

6. VEGETATION

The extremely high abundance of literature concerning vegetation studies in wetlands can make some clear simple ideas obscure. My interest is to get

[130] *ὅλος* = whole ; *ἀλκαλουχος* = alkaline in Modern Greek (cf. Holocene).
[131] *ἀλκαλουχος* = alkaline in Modern Greek.
[132] *ὄξος* = vinegar.
[133] *ὅλος* = whole ; *ὄξος* = vinegar.

closer to the vegetation reality from a landscape approach. Three main vegetation types may be presented:

6.0.1. xylohygrochore [134] forested wetlands
6.0.2. thamnohygrochore [135] scrub, shrub vegetated
6.0.3. poahygrochore [136] where herbs dominate

A second, more advanced classification can be made using the Raunkiaer biotypes.
6.1.1. fanerophytohygrochore [137] fruticose trees

6.1.1.1. macrofanerophytohygrochore [138] with proper trees
6.1.1.2. microfanerophytohygrochore [139] 2-8 m high trees
6.1.1.3. nanofanerophytohygrochore [140] .25-2 m high buds

6.1.2. chamaephytohygrochore [141] germs < .25 m, multibranched
6.1.3. hemicryptophytohygrochore [142]
6.1.4. geophytohygrochore/cryptophytohygrochore [143]
6.1.5. hydrophytohygrochore [144]
6.1.6. therophytohygrochore [145] annual

Nevertheless, Brockmann-Jerosch and Rübel in Switzerland have classified vegetation from a physiognomic criterion instead of stressing the significance of the dominant species in a landscape. Ligneous, woody formations (hyle [146]), herbs (poa) and deserts (eremia [147]) are distinguished.

6.0.1.1. ombrohylehygrochore [148] equatorial and monsoonal forest

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[134] *ξύλον* = wood (cf. xylolith) .
[135] *θάμνος* = scrub (cf. sclerothamnia).
[136] *πόα* = herb.
[137] *φαίνειν* = to show; *φῦτον* = plant (cf. Phanerozoic and hydrophyte).
[138] *μακρός* = long, big (cf. macroscale).
[139] *μικρός* = little (cf. microscope).
[140] *νᾶνος* = dwarf (cf. nanosecond).
[141] *χαμαί* = on the ground; *φῦτον* = plant (cf. chamaephyte).
[142] *ἡμί* = half; *κρυπτός* = hidden (cf. hemisphere and cryptic).
[143] *γῆ* = earth (cf. geography).
[144] *ὕδωρ, ὑδάτος* = water (cf. hydrodynamic).
[145] *θέρος* = summer (cf. therodrymia).
[146] *ὕλη* = wood, matter (cf. hylomorphism).
[147] *ἐρήμια* = desert (cf. eremite).
[148] *ὄμβρος* = rain; *ὕλη* = wood.

6.0.1.1.1. ombrodrymiahygrochore [149] true forest
6.0.1.1.2. ombrothamnohygrochore [150] mainly mangroves

6.0.1.2. chimohylehygrochore [151] tropical ligneous formation

6.0.1.2.1. chimodrymiahygrochore trees
6.0.1.2.2. chimothamnohygrochore shrubs

6.0.1.3. daphnohylehygrochore [152] lauroid formation

6.0.1.3.1. daphnodrymiahygrochore trees
6.0.1.3.2. daphnothamnohygrochore shrubs

6.0.1.4. sklerohylehygrochore [153] mediterranean formation

6.0.1.4.1. sklerodrymiahygrochore
6.0.1.4.2. sklerothamnohygrochore

6.0.1.5. therohylehygrochore [154] deciduous temperate formation

6.0.1.5.1. terodrymiahygrochore
6.0.1.5.2. terothamnohygrochore

6.0.1.6. belonehylehygrochore [155] aciculifolious, needle leaved formation

6.0.1.6.1. belonedrymiahygrochore
6.0.1.6.2. belonethamnohygrochore

6.0.2.1. acropoahygrochore [156] savanna like formations
6.0.2.2. sphagnopoahygrochore [157] mossland, moorland
6.0.2.3. aeiphyllopoahygrochore [158] atlantic evergreen meadows

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149 *ὄμβρος* = rain; *δρυμών* = woodland.
150 *ὄμβρος* = rain; *θάμνος* = shrub.
151 *χειμών* = winter.
152 *δάφνη* = laurel.
153 *σλκηρός* = hard (cf. sclerotic).
154 *θέρος* = summer.
155 *βελόνη* = needle.
156 *ἄκρος* = high; *πόα* = herb.
157 *σφαγνός* = Sphagnum.
158 *ἀείφυλλος* = evergreen.

6.0.3.1. xeroeremihygrochore [159] hot deserts
6.0.3.2. cryoeremihygrochore [160] cold deserts
6.0.3.3. paralioeremihygrochore [161] coastal, littoral deserts
6.0.3.4. petroeremihygrochore [162] rock deserts

6.2. Plant nutrients

In relation to the nutrient state plant communities can be further classified as

6.2.1. eutrophohygrochore [163] well fed
6.2.2. mesotrophohygrochore [164] median food supply
6.2.3. oligotrophohygrochore [165] bad fed

6.3. Communities colonisation strategy

When the way of conquering new land by the different species is studied , it seems clear that plant communities can extend their *Lebensraum* feeding up the hygrochores. Some authors agree on a terrestrialization process (*Verlandungsvorgang* in German) from the margins to the centre, which is most commonly found when huge amounts of sediments fill the basin, differing from another where hydrophytes come from the bottom of the hollow and colonize the beach-like edges.

6.3.1. anaplethohygrochore [166] ascending colonization
6.3.2. cataplethohygrochore [167] descending colonization

7. WILDLIFE

This part of the classification is quite difficult to control for me because of my own unexperience. Therefor I have just tried to organise the different phyla wit-

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[159] *ξήρος* = dry; *ἐρήμια* = desert.
[160] *κρύος* = ice, frost; *ἐρήμια* = desert (cf. cryology).
[161] *παραλία* = sea fringe (cf. paralic).
[162] *πετρός* = rock (cf. perology).
[163] *εὖ* = right, well; *τροφή* = food (cf. eutrophic).
[164] *μέσος* = median (cf. mesology).
[165] *ὀλίγος* = poor, little (cf. oligoelements).
[166] *ἀνά* = up; *πλήθειν* = to fill up (cf. analyse and plethoric).
[167] *κατά* = down (cf. catalytic).

hin the animals. But phylogenetics has nothing to do with ecosystems. It would be better if another more environmental classification could come through.

7.1. Animal taxa

7.1.1. Spongiaria
7.1.2. Coelenterata
7.1.3. Platyhelminths
7.1.4. Nemertes
7.1.5. Mollusca
7.1.6. Annelida
7.1.7. Arthropoda
7.1.8. Echinodermata
7.1.9. Bryozoa
7.1.10. Cordata

7.1.10.1. Pisces
7.1.10.2. Amphibia
7.1.10.3. Reptilia
7.1.10.4. Aves
7.1.10.5. Mammalia

7.2. Animal behaviour

7.2.1. ecohygrochore [168] a place to live in

7.2.1.1. genohygrochore [169] a place to be born at
7.2.1.2. anaspahygrochore [170] a place to grow up
7.2.1.3. summeixohygrochore [171] breeding place
7.2.1.4. neossihygrochore [172] nesting place
7.2.1.5. oohygrochore [173] a place to spawn
7.2.1.6. edohygrochore [174] a feeding place

7.2.2. thanatohygrochore [175] a place to die at

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[168] *οἴκειν* = to live (cf. ecology).
[169] *γένος* = birth (cf. genetic).
[170] *ἀνασπᾶν* = to grow up.
[171] *σύμμειξις* = breeding.
[172] *νεοσσία* = nest.
[173] *ᾠόν* = egg (cf. oolith).
[174] *ἔδειν* = to eat.
[175] *θάνατος* = death.

8. LAND USE

This classification would not be completed if land use and management were ignored. Nowadays social-economic studies try to incorporate wetland functions and values so that during the final assessment not only pure technical and net economic decisions are taken but global ones, integrating geosystemic, that is ecological or geomatic items. Wetlands have been —and are already— used in diverse ways from one place to another. From the arctic regions where after general thawing wetlands appear and are grazed by ruminants, to the rice paddy fields of the Asian SE world, wetland management and profit may show a very open fan. Some of the more characteristic land uses are listed hereunder.

8.1. Primary activities

8.1.1. georgiohygrochore [176] agriculture

8.1.1. sitohygrochore [177] cereals

8.1.1.2. orhyzohygrochore [178] rice fields
8.1.1.3. lachanohygrochore [179] vegetables
8.1.1.4. osprihygrochore [180] legumes

8.1.2. ctenohygrochore [181] cattle
8.1.3. orchohygrochore [182] forestry
8.1.4. metallahygrochore [183] mining, quarrying

8.1.4.1. porohygrochore [184] calcrete
8.1.4.2. turfohygrochore [185] turf
8.1.4.3. lithotomohygrochore [186] stone quarry

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[176] *γεωργία* = agriculture (cf. George).
[177] *σῖτος* = wheat (cf. sitosterol).
[178] *ὀρύζα* = rice.
[179] *λάχανον* = vegetables.
[180] *ὄσπριον* = legume.
[181] *κτῆνος* = cattle.
[182] *ὄρχος* = tree line, garden.
[183] *μέταλλον* = mine (cf. metallic).
[184] *πώρος* = calcrete, travertine (cf. styropore).
[185] *τυρφη* = turf, peat.
[186] *λιθοτομία* = stone cutting.

8.1.5. cynegesiohygrochore [187] hunting
8.1.6. halihygrochore [188] fishing
8.1.7. therismohygrochore [189] other recollecting uses
8.1.7.1. orophohygrochore [190] thatching
8.1.7.2. naupegihygrochore [191] ship building
8.1.7.3. causimohygrochore [192] fuel

8.2. Secondary activities

Actually no industrial activities are related to wetlands but cleaning of industrial litter is possible and desirable.

8.2.1. lusihygrochore [193] denitrification, water clearing and cleaning, pollution battle

8.3. Tertiary activities

8.3.1. chrematohygrochore [194] bussiness, commerce
8.3.2. naohygrochore [195] navigation
8.3.3. scholehygrochore [196] leisure
8.3.4. pedagohygrochore [197] environmental education
8.3.5. stategohygrochore [198] military use
8.3.6. ochetohygrochore [199] drainage, reclamation

9. CONCLUSION

To summarise all the above mentioned ideas I would like to express how diverse are the meanings of the word wetland. If we use terms from a given language these words are always burden with commonly agreed meanings or

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[187] *κυνηγέσιον* = hunting (cf. cynegetic).
[188] *ἁλίεια* = fishing.
[189] *θερισμός* = recollection.
[190] *ὄροφος* = thatching.
[191] *ναυπηγία* = ship building.
[192] *καυσιμός* = combustible (cf. caustic).
[193] *λουσία* = wash.
[194] *χρῆμα, χρήματος* = business (cf. chrematistic).
[195] *ναῦς* = ship (cf. naumachia).
[196] *σχολή* = leisure (cf. school).
[197] *παιδαγογία*= education (cf. pedagogue).
[198] *στρατεγός* = military forces commandant (cf. stategy).
[199] *ὀχετός* = aqueduct, drainage.

with personal implications. It is difficult —if not impossible— to agree on what are the connotations of words such as «mire», «fen», «peatland», «swamp» and to separate them from «marsh». Some authors have based the difference between mire and marsh upon the greater mineral meaning of soil in marshes and on the organic matter content of mires or peatlands. In order to avoid all the used terms to be explained and to coincide on the meaning of all words, I propose to use Greek rooted neologisms. Moreover these created words have no other meaning but what is literally said.

Efforts should be made in the future to produce a unifying legend on wetland typology. Some examples can be taken into account as soil classification according to FAO, or American Soil Taxonomy based on Greek, Latin and other languages' roots. Combinations of nouns and composed adjectives could be the only way to correctly and thoroughly describe the complexity of hygrochores.