amphibious human blueprint

species : ***Homo sapiens***

a coherent picture of arguments used in various ***waterside hypotheses*** *(incl. the* ***aquatic ape hypothesis****) in human evolution*

natural habitat : ***coasts & beaches***

swimming & floating

- human is **the best swimmer** & **diver** among the apes, capability lasts **from birth to death**
- various **swimming gaits** like breaststroke, front crawl...

dark skin pigment blocks sunlight in tropical waters ③

reduced body hair & **smooth skin surface** reduce drag ①

subcutaneous fat layer
- prevents heat loss
- increases buoyancy
- streamlines the body ①

fusiform, straight, streamlined body reduces drag ①

rare condition of **webbed toes** ②

force exerted on **the first** & **the last toes** (like in seals) ⑤

paddle-like feet with fused toes for both water & land locomotion ⑤

scooper-like hands with thumb webbing for catching water ②

flexible arms & shoulders produce directional strokes ②

rare condition of **webbed fingers** ②

hair growth pattern follows water flow ①

armpit & **pubic hair** reduces turbulent flow in concave surfaces ⑥

lower normal body temperature with **low fluctuations** like in aquatic mammals ⑤

long legs produce powerful propelling force in swimming, diving & running ②

water birth the natural way of laboring in human
- less painful, low risk
- preferred by women
- infant mortality & infection rates no higher than land births
- practiced in primitive cultures ⑨

infant are able to swim/dive **before** being able to crawl/walk, **no fear or harm** caused by immersion ②

> 1 year voluntary movements, starts **learning** to swim, dive, walk... ⑨

4-12 months **infant floating reflex**: rolls onto the back to float & breathe ⑨

0-4 months **infant diving reflex**: opens eyes, holds breath, rhythmic limb movements to propel forward ⑨

pregnancy & infancy

immersion relieves pain, reduces stress hormones (**adrenaline**) & facilitates "love" hormone (**oxytocin**) ⑥

more body fat, darker & **smoother skin** during pregnancy for open sea immersion ⑥

large floating breasts help feeding while immersed ⑤

brown fat tissues generates heat ③

abundant body fat prevents heat loss & increases buoyancy ②

multi-lobed kidney (reniculi) as in marine mammals (fused later) ⑥

strong muscles in chin, cheek & lips for close contact suckling, avoid water goes in ⑥

vernix caseosa (waxy substance with **squalene** on newborns) with waterproofing & antibacterial properties ④⑥

newborn **holds breath** until reaching water surface ⑨

umbilical cord long enough for newborn to reach water surface ⑥

no practice of eating placenta (placentophagy) as not possible in water ⑥

gender & sex

longer scalp hair (becomes **thicker** & **stronger** during pregnancy) for the floating infant to cling on ②

protruding buttocks (in extreme case **steatopygia**) as a platform for carrying baby ⑤

estrogen causes **fat** stored around **buttocks, thighs & hips** to form the fusiform body ⑥

longer vaginal canal isolates the uterus from sea water ④

labia major & **hymen** waterproof the vagina, avoid infection in sea water ④⑨

menstruation synchronized with lunar (tidal) cycle ④

hidden estrus due to visual signals (genital swelling) & scent signals (pheromone) not efficient in water ④

more **face-to-face sex** due to straight body plan, vagina directed towards the front ②

bald head smoothens the forehead ⑩

facial hair streamlines the areas under the chin, nose & ears for diving ⑩

foreskin avoids infection in sea water ⑥

longer penis in response to deeper vagina ④

walking & running

bipedalism & **upright posture** may arose from **wading**
- for shallow water foraging
- supported by water buoyancy
- overcame various disadvantages ①⑧

obligatory bipedalism due to straight body & long legs (diving) ②

endurance running only **recently evolved**
- pre-adaptations: strong legs, good balancing...
- new adaptations: eccrine sweating, foot arches, short toes... ⑩

inherited from ape ancestors:
- climbing, gymnastics
- partial bipedalism & partial upright posture
- opposable thumb

diving & foraging

- **underwater foraging** important to early *Homo sapiens*, still practicing among coastal tribes
- **collecting shellfish** & **hunting fish** for food, precious **shells** & **pearls** for trading
- **bimodal diving pattern** similar to sea otters (serial short dives to <20m, separated by recovery intervals, in extreme cases **dive to 100m**) ⑥

fewer & larger red blood cells, higher concentration of **hemoglobin** ⑤

spleen contracts to release extra red blood cells ⑥

flexible backbone allows "dolphin kick" & navigating under water ②

agile neck for searching ⑥

descended larynx allows breathing through the mouth ③

better **voluntary breath control** for planning of inhalation ②

breathing pattern (quick inhale & slow exhale) similar to speech ③

fine breath control pre-adapted for **speech**

dexterous, sensitive hands for collecting & hunting, started **tool-making** on the shore ①

enhanced **diving reflexes**

bradycardia: heartbeat reduces during immersion ②

peripheral vasoconstriction: blood flow to limbs cuts down to save oxygen for important organs ⑥

blood shift: blood plasma flows into lungs & cavities in extreme depth to prevent organs crushed ⑥

multi-pyramidal kidneys excrete salt from sea water ⑥

higher production of urine during dives (immersion diuresis) removes salt ⑥

high output of water & salt: abundant sweat & tears, saturated expiration, dilute urine, watery feces ⑤

sweat (perhaps also **tears**) excretes excess salt ②

head & upper body

- **waterproofing** & **thermoregulation** in the head & upper body – usually out of water; **insulation** in the lower parts
- **oral cavity modified** for aquatic diet, later enabled **speech**
- **brain enlargement** enabled by marine diet
- **senses attuned** to aquatic environment

greasy hair for waterproofing ③

scalp hair blocks sunlight in the tropical waters ①

round-shaped head (reduced brow ridge, flat face, **flat ears**) reduces drag ⑥

eyebrows & **eyelashes** prevent water flow into eyes ⑥

paranasal sinuses assist the head floats above water surface ⑤

downward nostrils avoid water splashes in ②

upper lip & **philtrum** enable sealing of nostrils while diving ④⑥

- **specialized oral cavity** (small mouth, round jaw & palate, reduced teeth, round versatile tongue) for **suction feeding** of slippery seafood, pre-adapted for **speech**
- **thick molar enamel** for cracking hard shellfish ⑥

low drinking capacity, low tolerance to **dehydration** ⑤

vestigial air sacs (laryngeal saccule) used to aid floating in ape ancestors ⑥

ear wax (contains sebum) avoids water enter ears ⑩

sebaceous glands secret **sebum** (with **squalene**) for waterproofing (in head, upper body, back) ③

sweat evaporates through the upper body (highest rate in head, upper body, back) ⑥

remnant **brown fat tissues** generate heat (only in neck, upper chest) ⑥

recent brain shrinkage due to change to riverine & terrestrial habitat ②

brain enlargement enabled by **marine diet** (seafood, seaweed)
- high availability & reliability
- essential **micronutrients** (DHA, iodine, zinc, selenium...) ⑦

brain enlargement & reorganization led to **higher intelligence, creativity** & **syntactic ability** ⑦

syntax + **speech/song** = **human language**

speech, song & **facial expressions** replaced body expressions as more efficient above water surface ②

vocal learning, speech & **song** enabled by
- fine breath control (for diving)
- enhanced articulating apparatus (for aquatic diet) ⑥

enlarged semicircular canals give better balance under water & on land (bipedalism) ②

myopia & **astigmatism** correct for light refraction in water ⑩

superb **underwater vision** by maximally constricting pupils ⑥

color vision & **color blindness** adapted to aquatic environment ⑥

reduced smelling sense as useless in or above water ②

thicker lips for testing allergens in seafood ⑥

no salt hunger & **high tolerance in salty taste** since salt is everywhere in the sea ③

umami taste is the most prevalent in seafood ⑥

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