Growth in human group size as the cause of society's challenges from possible gene pool signaling impact

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A short speculative hypothesis is presented implying that many of the ailments or catastrophes of human society could be due to primordial "gene pool" signaling, or due to gene pool signal degradation, as the growth of human social groups far exceeded the gene pool's capabilities. Humans are considered as components of gene pools where gene pools have a "distributed intelligence" capable of signaling to all of its individual human components. Gene pools may maintain an ability to influence groups or populations, particularly in times of scarcity or extinction, whereby entire beliefs, cultures, strife, propensity toward violence, and individual and group behaviors are influenced. Beyond a certain "group size," or a rate of component change, this gene pool signaling is degraded or even corrupted perhaps leading to otherwise irrational behaviors like wars, genocide, extreme inequality, or paralysis against long term existential threats like climate change.

> *Superorganisms … are capable of the so-called "distributed intelligence", which is a system composed of individual agents that have limited intelligence and information. These are able to pool resources so that they are able to complete goals that are beyond reach of the individuals on their own. Existence of such behavior in organisms has many implications for military and management applications, and is being actively researched [1].*
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> *A pheromone is a secreted or excreted chemical factor that triggers a social response in members of the same species. Pheromones are chemicals capable of acting like hormones outside the body of the secreting individual, to affect the behavior of the receiving individuals [2].*
>
> *The term "herd" is also applied metaphorically to human beings in social psychology, with the concept of herd behavior. … The term has acquired a semi-technical usage in behavioral finance to describe the largest group of market investors or market speculators who tend to "move with the market", or "follow the general market trend". This is at least a plausible example of genuine herding, though according to some researchers it results from rational decisions through processes such as information cascade and rational expectations. Other researchers, however, ascribe it to non-rational process such as mimicry, fear and greed contagion [3].*

The realization of the concept of an *ecosystem* was a critical turning point in the history of mankind. However, even today, too often the mindset of the vast number of humans involves a paradigm of humans separate from, if not superior to, Nature. Philosophies and paradigms with our minds or spiritual souls outside of our bodies carries over into the idea of humans as external observers of our planet and natural world. Thus, we have a possible cause of why humans are not able to identify, or perhaps acknowledge, that major increases in human population might have a dramatic effect on the global ecosystem. Even with the recent focus on global climate change (global warming), animal extinctions, and pollution as direct impacts of human civilization i.e., the Anthropocene Era [4], there is little focus on how those changes may have affected human groups themselves. Consider how with such incredible improvements in science, technology, medicine, communication, education, chemistry, transportation, and manufacturing, humanity still has so many wars, conflicts, pollution, crime, genocide, extinctions, discrimination, illness, inequality, and climate damage. Might we all be missing something? Might the colloquial answer that such scourges "have always existed and always will exist," be a lame excuse?

In the last few decades mankind has seen many similarities between biological organisms in ecosystems and information technology systems in the marketplace. Both fields have advanced in environments of evolutionary fitness and adaptation. Computing systems have developed along similar lines of miniaturization, decentralized control, and complex signaling. Neural networks have even begun to approach structures and methodologies similar to human brains. As Anil Ananthaswamy noted in his 2020 article on how *Even human brains must partition information processing:*

> They built their deep net with four layers: three that modeled processing layers in the fruit fly and an output layer. When Yang and colleagues trained this network to classify the simulated odors, they found that the network converged on much the same connectivity as seen in the fruit fly brain: a one-to-one mapping from layer 1 to layer 2, and then a sparse and random (7-to-1) mapping from layer 2 to layer 3. … This similarity suggests that both evolution and the deep net have reached an optimal solution [5].

But it is the prevalence of signaling in both biological (Figure 1) and information technology (Figure 2) paradigms that is striking for the hypothesis in this paper. Each year additional mechanisms are found in the human body involving newly discovered systems for signaling whether it is signaling for mood or even clock signaling from gut microflora to signaling via the vagus nerve to telomeres to epigenetics to internal organs with their own "clocks" to aid the brain with time keeping that is so critical to the body's functioning - in an equivalent manner to that of I.T. computer systems and telecommunication [6].

The major influence of pheromones on the behavior of organisms in a gene pool is also of significant importance for this hypothesis [7]. The realization of the magnitude of the impact of pheromones on organisms and as an external signaling mechanism lends support that to the idea that gene pools have an ability to influence groups of organisms and that other external signaling mechanisms will likely be found in the future. Karlson and Luscher in their 1959 Nature paper define pheromones as "airborne chemical signals released by an individual into the environment and affecting the physiology and behavior of other members of the same species" [8]. Ivanka Savic and team in 2009 noted that "both volatile and nonvolatile compounds can act as pheromones. These chemical signals provide information about gender and reproductive status, and mediate social and sexual behaviors, as well as neuroendocrine changes" [9].

Consider the success of ants and their colonies on the planet. These groups known as ant colonies can be as large as 307 million members [10]. Yet even this insect species, with such large numbers in their groups, use significant amounts of chemical signaling to influence a variety of behaviors. In their 2017 research paper *Ants regulate colony spatial organization using multiple chemical road-signs*, Yael Heyman et al., note:

> Communication provides the basis for social life. In ant colonies, the prevalence of local, often chemically mediated, interactions introduces strong links between communication networks and the spatial distribution of ants. …at least three of these chemical signatures are functionally meaningful and allow ants from different task groups to identify their specific nest destinations, thus facilitating colony coordination and stabilization. The use of multiple chemicals that assist spatiotemporal guidance, segregation and pattern formation is abundant in multi-cellular organisms. … The description of the social insect colony as a superorganism (or social-organism) has proven to be a useful analogy of exceptional breadth. Our work suggests the addition of yet another layer to this correspondence by relating the nest chambers to different organs, and the ants to migrating cells. Using the principles of stigmergy, passively or actively generated chemicals serve as the superorganism's chemokynes. Multiple chemical signals serve to differentially guide and stabilize trafficking and organization of the mobile agents that make up the whole [11].

Thus, it is the hubris of mankind, with biases from historical beliefs in our "free will" of any action, the denial of the influence and intelligence of the ancient subconscious mind [12] and gene pool signaling via chemicals like pheromones, and our belief in our separation from (and superiority to) Nature that makes us believe we could not be influenced in a similar manner as ants even as the population of ant "cities" is larger than ours. While ant colonies comprised of tiny insect workers and queens can top over 100 million, most human cities or metropolitan areas peak at 50 million and the most "common population definitions for an urban area (city or town) range between 1,500 and 50,000 people, with most U.S. states using a minimum between 1,500 and 5,000 inhabitants" [13]. Compare this size to the average size of most large animal groups (Figure 3) and we can see that in terms of large organisms, human "group size" has grown tremendously larger than the group sizes of all other large organisms [14].

Speculations

Consider the classic example of an island where an over-grown population of rabbits is "held in check" (akin to a "circuit breaker" action) by a pandemic virus that allows the ecosystem to avoid the starvation of all rabbits and the collapse of the entire food chain. Might similar signaling mechanisms be in place per given gene pools that mediate "group size" to prevent gene pool and entire ecosystem extinctions? Could the success of human beings with our intelligent minds and science and technology have led to a growth in human group size that was so extreme and fast that ecosystem and gene pool mechanisms have yet to adapt to "keep up?" Consider how while lighter skin humans have evolved an adaptation to living in higher latitudes with less sunlight, the majority of humans have not and, thus, they suffer from winter Seasonal Affective Disorder as, while we as a species have been successful in colonizing areas far above the equator, our bodies have yet to fully adapt to the impact of reduced sunlight. If gene pool signaling, in an equivalent manner, is hundreds of years behind its ability to communicate or control large human groups, what might this mean for us as a species? While it might be considered an exercise or challenge for complexity scientists and supercomputers to determine what is optimal for humans in terms of the size and rate of change of a successful and healthy human "group size" or population or nation, there is reason to believe that our current numbers may be well in excess of either the gene pool signaling capacity or even the carrying capacity of the planet. It is the exponential growth of human population (Figure 4) that almost assures the existence of conflicts with ecosystem capacities [15].

We could speculate further on what the effects could be of a system which for eons has been based on "centralized control" that cannot adapt to its components that have become nearly fully autonomous. Again, given the impact of chemical signaling mechanisms like pheromones and even the impact of hormones like oxytocin on behaviors, it is not beyond the realm of belief to consider that a gene pool involving a distributed intelligence could "manage" behaviors of its organisms in a given group to optimize the gene pool and perhaps the ecosystem's survival.

What might an ecosystem in this model become as a gene pool's population has grown far beyond its limit or control? Might our intelligence, for all intents and purposes, go "insane" from loss of control and excess multi-tasking and tracking? Imagine a scenario like post World War 1 Germany with starvation and hyperinflation. Does a gene pool that is too large that falls into an existential "state of panic" thus move toward primordial mechanisms in the form of "central control" as represented by fascist and dictatorial leaders? Do human populations follow en masse "men of power" as primordial signaling has led to a panic or perhaps a group size is too large thus the lack of signaling has led to a subconscious state of panic amongst most of its members? During times of existential crisis are ethical parts of the brain reduced (consider vis a vis cannibalism amongst starving shipwreck survivors on deserted islands) and, thus, behaviors or ancient "programs" like violence and war, necessary to secure scare resources like food and shelter, are prioritized at the expense of others? Can this proposed signaling, or lack thereof, actually affect an entire country's population? Are genocides, wars, economic inequality, etc. thus all possibly caused by human population sizes exceeding their natural limits or the limits of a gene pool's signaling control that has for millennia worked with a significantly smaller human "group size?" This paper does not seek to prove this hypothesis but, rather to present the possibility for future scientists to consider as they continue to discover additional mechanisms of signaling in humans and their populations.

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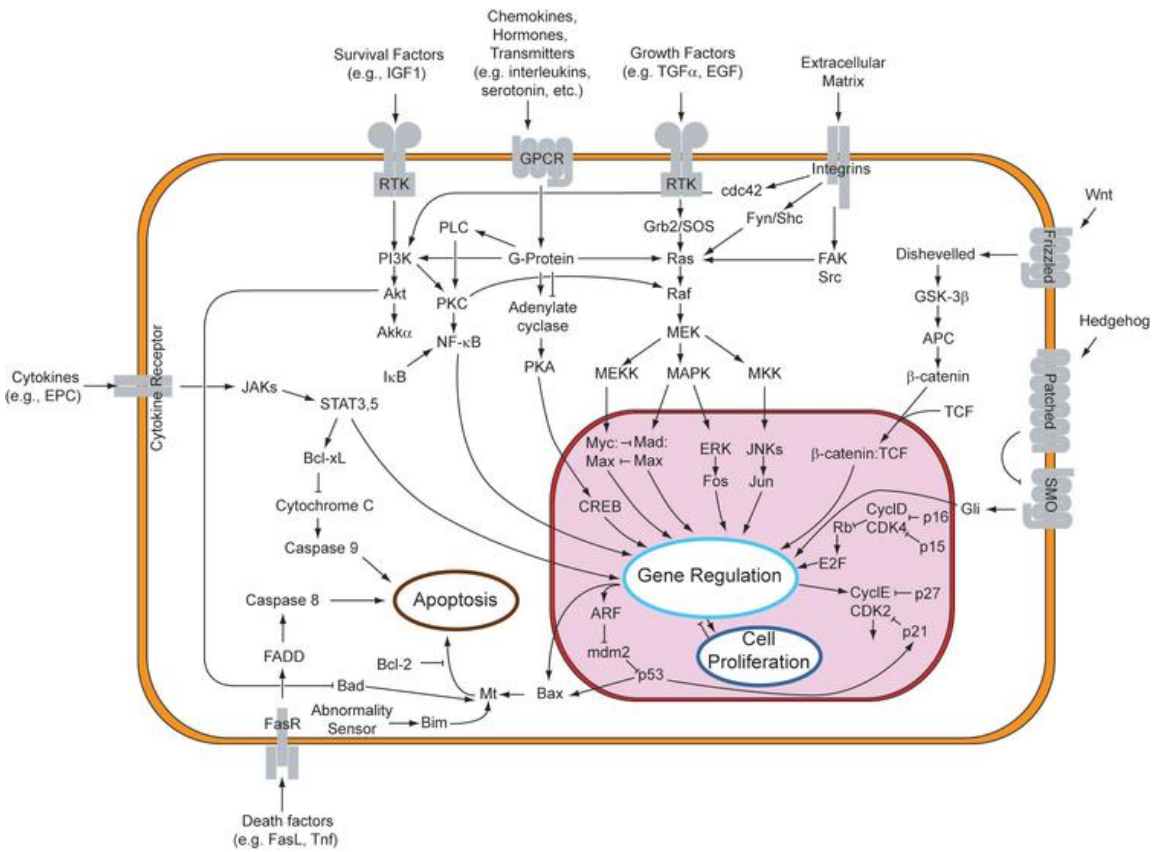
Figures

Figure 1.

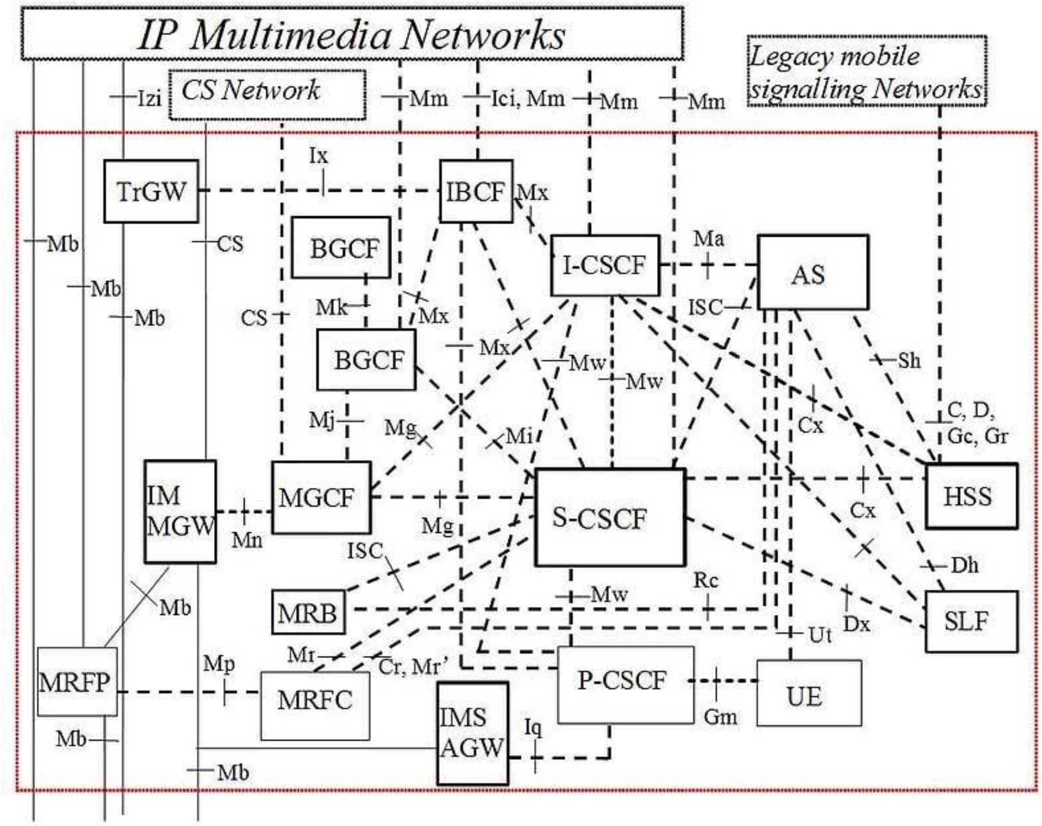
Nature has developed incredibly complex signaling mechanisms including the many components used for signaling of cells in life.



Source: Wikipedia contributors. (2022, December 17). Cell signaling. In Wikipedia, The Free Encyclopedia. Retrieved 22:43, December 25, 2022, from https://en.wikipedia.org/w/index.php?title=Cell_signaling&oldid=1127907543

Figure 2.

Information technology systems have matured into large scale network and compute systems with complex signaling methods.



Source: https://www.metaswitch.com/knowledge-center/reference/what-is-ims-ip-multimedia-subsystem
What is the IP Multimedia Subsystem (IMS)?

Figure 3.

The tremendous success of human beings (homo sapiens) on planet earth has led to large communities of humans organized into towns, cities, and nations all much larger than the mean or max "group size" of other large animals.

Group (or colony) size distribution measures of various birds and mammals

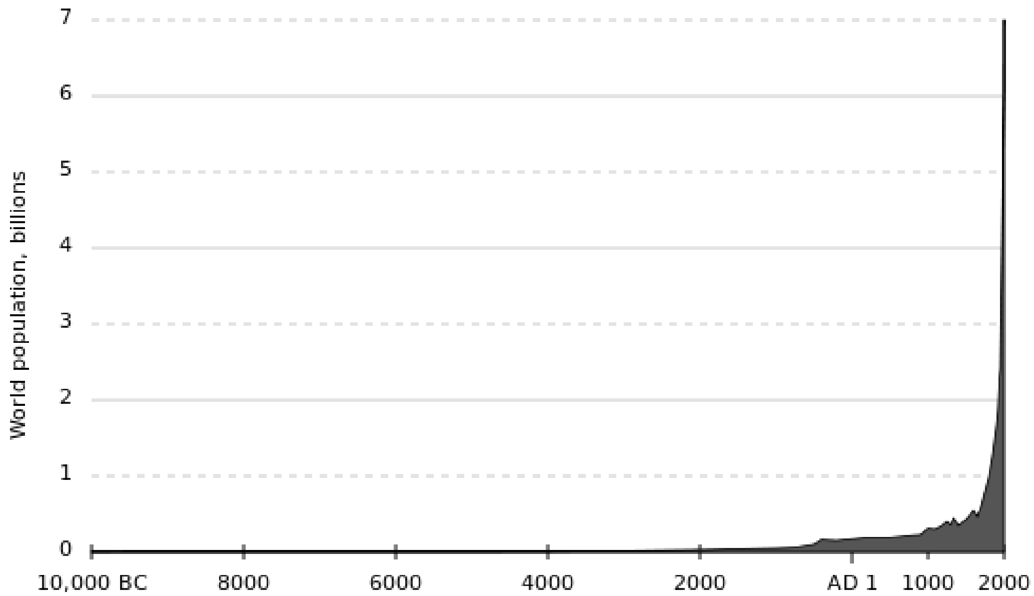
Common name	Scientific name	Sample size (number of groups observed)	Group size: Min	Median	Mean	Max	Mean crowding	Source
Adelie penguins, feeding flocks	*Pygoscelis adeliae*	553	1	1	2.0	14	3.2	Norman & Ward 1993
Adelie penguins, travelling flocks	*Pygoscelis adeliae*	244	1	5	5.4	26	8.3	Norman & Ward 1993
African buffalo	*Syncerus caffer*	157	50	150	306.1	1550	595.9	Sinclair 1977
African wild dog	*Lycaon pictus*	229	3	9	9.3	24	11.5	Creel 1997
Alpine marmot	*Marmota marmota*	250	2	4	5.0	20	6.5	Grimm et al. 2003
American bison	*Bison bison*	1016	1	4	5.6	38	11.9	Lott & Minta 1983
American white pelican (pairs)	*Pelecanus erythrorhynchos*	41	20	300	1632.9	14900	6641.4	King & Anderson 2005
Bohor reedbuck	*Redunca redunca*	301	1	1	1.8	26	3.8	Wirtz & Lörscher 1983
Bonobo	*Pan paniscus*	99	1	5	6.7	18	9.45	White 1988
Bushbuck	*Tragelaphus scriptus*	69	1	1	1.5	4	1.9	Wirtz & Lörscher 1983
Canada goose	*Branta canadensis*	920	1	6	6.8	20	9.9	Elder & Elder 1949
Chimpanzee	*Pan troglodytes verus*	267	1	4	5.3	22	9.1	Tutin et al. 1983
Chinese water deer, winter	*Hydropotes inermis*	1080	1	1	1.6	7	2.1	Sun 2002
Common dolphin	*Delphinus delphis*	920	5	30	65.5	1000	219.3	Anonymous 2005
Divers	*Gavia spp.*	379	1	1	1.7	40	5.3	Noer et al. 2000
Glossy black-cockatoo	*Calyptorhynchus lathami halmaturinus*	916	1	5	7.8	60	15.9	Pepper 1996
Impala	*Aepyceros melampus*	1314	1	3	6.8	77	17.75	Wirtz & Lörscher 1983
Killer whale	*Orca orca*	424	1	4	4.2	15	5.5	Baird & Dill 1996
Kirk's dikdik	*Madoqua kirki*	44	1	1	1.3	3	1.5	Wirtz & Lörscher 1983
Lesser horseshoe bat, wintering	*Rhinolophus hipposideros*	30	1	16	43.8	204	122.1	Godlevska et al. 2005
Lesser kestrel (pairs)	*Falco naumanni*	51	1	2	4.7	42	16.1	Tella 1996
Mixed-species passerine flocks	*Passeriformes*	115	10	20	24.6	70	32.9	Hart & Freed 2003
Mountain reedbuck	*Redunca fulvorufula*	20	1	2	2.1	6	2.9	Wirtz & Lörscher 1983
Mouse-eared bat, wintering	*Myotis myotis*	21	1	14	26.8	127	77.3	Godlevska et al. 2005
Northern bobwhite quail	*Colinus virginianus*	378	1	11	11.0	22	12.8	Williams et al. 2003
Przewalski's gazelle	*Procapra przewalskii*	98	1	4	6.0	18	9.8	Lei et al. 2001
Red fox families, adults with helpers	*Vulpes vulpes*	14	1	2	2.6	5	2.9	Zabel 1986
Red-necked phalarope	*Phalaropus lobatus*	118	1	2	2.8	12	5.3	Pellinger 2004
Redshank	*Tringa totanus*	677	1	1	7.4	95	30.6	Cresswell 1994
Rook (pairs)	*Corvus frugilegus*	243	1	38	59.6	281	116.3	Debout 2003
Steenbok	*Raphicerus campestris*	26	1	1	1.2	3	1.3	Wirtz & Lörscher 1983
Steller sealion 2004	*Eumetopias jubatus*	166	1	80	174.9	1304	527.0	Fritz et al. 2006
Steller sealion 2006	*Eumetopias jubatus*	114	1	97.5	186.7	1319	569.2	Fritz et al. 2006
Striped dolphin	*Stenella coeruleoalba*	1085	5	30	57.3	800	168.8	Anonymous 2005
Thomson's gazelle	*Gazella thomsonii*	584	1	2	4.2	100	16.0	Wirtz & Lörscher 1983
Waterbuck	*Kobus ellipsiprymnus*	2082	1	3	7.1	166	24.7	Wirtz & Lörscher 1983
Whistling swan	*Cygnus columbianus*	735	1	3	4.2	13	6.1	Thompson & Lyons 1964

In case of aggregated distributions, the median group size is expected to be lower than the mean group size, and both these measures are expected to fall into the left part of the total range. All distributions in this data set, except for the northern bobwhite quail, fulfil these criteria (Some of the minimum and maximum values were slightly modified by rounding or pooling by the original authors and due to interpretation problems of graphical data.).

Source: Reiczigel, J., Lang, Z., Rózsa, L., & Tóthmérész, B. (2008). Measures of sociality: two different views of group size. *Animal Behaviour*, 75, 715–721.

Figure 4.

The exponential growth of humans on planet earth has likely exceeded some aspects of gene pool and ecosystem control and signaling mechanisms.



Source: LibreTexts. (2022, June 8). Human Population Growth. *General and Introductory Biology.* Retrieved December 26, 2022, from https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_%28Boundless%29/45%3A_Population_and_Community_Ecology/45.04%3A_Human_Population_Growth/45.4A_%3A_Human_Population_Growth