

Interaction with the Environment: Anthropological Cybernetic Model

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ABSTRACT

Cybernetics is primarily concerned with the transfer of information through, and (re)actions of systems. The research aim was to investigate models of interaction dynamics between an anthropological system and its environment. Equifinality dynamic model defined by three compartments and propensity for establishment of a steady state regardless of the initial conditions was applied. The intention was to apply this concept in anthropological research using the OPSIM procedure. DYNOPS model defined by four age-group compartments and the environment was also used. The model was applied on the census of the Bogomolje village on the island of Hvar (R. Croatia). Through numerous simulations, it was found that the influence of the environment increases with the decrease of time spent in the young age compartment. A drawback of DYNOPS model is that it places the environment in an unchangeable category, while in reality it necessarily changes through numerous interactions with various agents. Finally, cybernetics should not only be used to explicate, but also predict and correct undesired communal developments.

Introduction

The General Systems Theory (GST)¹ was first formulated in the mid twentieth century as a reaction to the then predominant reductionist views of science. It is evident from our published papers^{2–4} that we have been using principles of the GST for application of modeling in anthropological research. Furthermore, we have been pointing out the apparent similarity between cybernetics and the GST^{3,4} in

both theoretical and conceptual domains. Certain differences between these two fields stem from, and pertain primarily to the understanding of the concept of a »system«. The noted differences in conceptual perception take Ashby's^{5*} definition of a system as their point of origin. Furthermore, J. Engelberger expands Ashby's definition and states that a system may be defined as: »...an ensemble of the parts which are bound together, connected, coordinated by streams of infor-

* "A system is a set of elements selected by an observer."

mation which flow between them« (ibid.). Although we agree with these definitions, we feel bound to point out that every system is defined against the »background« of its environment (i.e. the universe), while its structures reflect input / output relations with that environment (the universe).

Cybernetics is primarily concerned with the transfer of information through a system which may in turn cause activation of feedback mechanisms and the resulting (re)actions of that system. Understanding and usage of these (re)actions, i.e. controls, necessarily presupposes establishment of certain »logic« schemes about the system. In fact, by using the system and its »logic« the user commits an indirect inference regarding its communication with the environment. Following Gödel's incompleteness theorem which states every non-contradictory system of axioms is incomplete since theoretically, there exists a claim which, using exclusively the initial set of axioms, cannot be proven nor refuted, one reaches the conclusion that every system is incomplete and thus liable to iterative cognitive and scientific-investigative upgrading. Such iterative upgrading of a system is conducted through investigation of the construction of system models. The development and application of cybernetics resulted in changing understanding of and about cybernetics, so that today scientific discourse concentrates on second order cybernetics⁶ including the roles of positive feedback loops and the observer⁷. In that respect, cybernetics is used in epistemological discussions about complexity.

Human communities are also complex systems that may be observed and/or investigated from the point of view of the systems theory and cybernetics, wherein basic postulates of the systems theory should be taken as points of origin in construction of anthropological demographic models³. In terms of the systems theory, anthropological models perceive human

community as a system^{3,4} that interacts with biological and socio-cultural^{8,9} factors in the environment through reproductive rate, mortality, emigration, immigration and relationships between age groups.

In terms of the above stated contextual relationship of anthropology and cybernetics, the aim set to accomplish in this research was to investigate a model of dynamics of interaction of an anthropological system and its environment, with the purpose of applying the obtained data in further research and practice. As the starting point of our investigation, we have used a dynamic model (equifinality)⁹ with a propensity for the establishment of a steady state regardless of the initial set of conditions. Our intention was to adjust this concept for application in anthropological research using the OPSIM procedure^{3,4} while at the same time, a portion of our work consisted of redesigning the existing program used in previous research^{3,4}.

Investigation of the basic characteristics of the model, as well as that of the influence of specific constants (i.e. how does communication with the environment as opposed to reproductive potential of a population influence the model) have been conducted for the purpose of enhancing the cybernetic OPSIM model. Furthermore, the purpose of the investigation of the DYNOPS model was the assessment of potential use of such a model for interaction of various environmental factors and conditions of human population as viewed from the anthropological standpoint. The goal of this research is to set a simple (theoretically predictable) cybernetic steady state model reflecting the dynamics of interaction between an anthropological system and its environment.

Equifinality dynamic model (EDM)

Figure 1 depicts the dynamic model applied by Bertalanffy⁹ for interpretati-

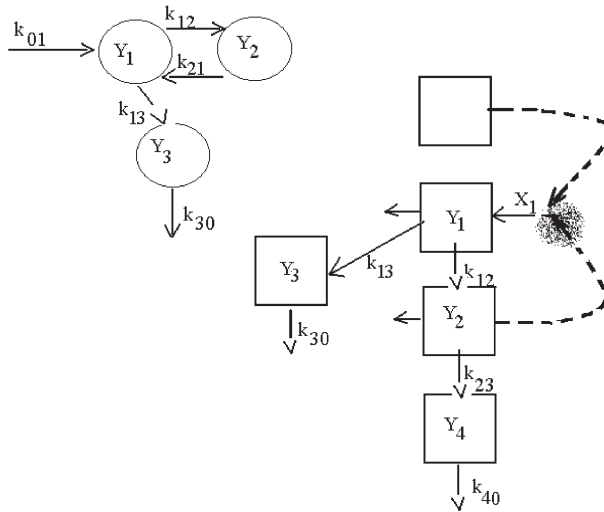


Fig. 1. Dynamic model and OPSIM simulation.

on, explanation and characterization of the establishment of a steady state independent of the initial set of conditions existing in an environment-communicating system. The model is set by three compartments (y_1, y_2, y_3), which are interconnected by flows k_{ij} , wherein «i» designates the initial compartment and «j» the destination compartment. Interaction with the environment (X) is set by the $(1/K)(X - y_1)$ relationship. Thus the rate of input into the first compartment (input, X_1) depends upon the conditions in the environment (X), the conditions in the first compartment (y_1), and the constant of communication with the environment « $1/K$ ». The following expressions describe changes in compartment contents during a given time interval (dt):

$$dy_1/dt = (1/K)(X - y_1) + K_{2,1}y_2 - K_{1,2}y_1 - K_{1,3}y_1$$

$$dy_2/dt = K_{1,2}y_1 - K_{2,1}y_2$$

$$dy_3/dt = K_{1,3}y_1 - K_{3,0}y_3$$

The system is characterized by the establishment of a steady state maintained by dynamic processes. In case of external disturbances, the steady state is restored by negative feedback loops. In the steady state (ss), the ratios of compartmental contents do not depend on the environment but exclusively upon flow constants ($y_{1ss} : y_{2ss} : y_{3ss} = 1 : K_{1,2}/K_{2,1} : K_{1,3}/K_{3,0}$). The content of the first compartment in the steady state is constant ($dy_1/dt = 0$), and depends upon the output flow $F_{1,3}$, environmental conditions (X) and the constant of communication with the environment $y_{1ss} = (X/K)/((1/K) + (F_{1,3}))$. The following paragraph brings an account of application of the dynamic model in description of interaction between a community and its environment.

DYNOPS model

Rudimentary Simulation Program (RUSIP)** was used in investigation of the basic characteristics of the dynamics model. The program is designed to solve

** In Croatian language: **Opći simulacioni program** – OPSIM2

the conditions in a network of compartments (N) characterized by controllable contents and flows. DYNOPS model (Figure 2), is defined by four compartments and the environment (X). If applied on demographic data, the compartments are defined by age group boundaries.

Y_1 = population of 0–20 years of age (youth: pre-reproductive compartment)

Y_2 = population of 20–45 years of age (reproductive compartment)

Y_3 = population over 45 years of age (wise people: post-reproductive compartment)

Y_4 = supplementary compartment, stratum of the population eliminated from the observed system due to emigration or reproductive exclusion.

The input flows (F_0, i) representing the influx of immigrants are not set in this model. The output flows ($F_i, 0$) representing elimination out of the system (through death and emigration) are set according to estimated mortality rate for a specific age group in the Republic of Croatia³. Finally, the transit flows $F_{1,2}$ and $F_{2,3}$ are set according to estimated

mean transit time (Tt) as defined in the formula below^{10,11}:

$$Tt = \frac{\int_0^t R(t)dt}{R(t)}$$

$R(t)$ designates contents of the system at a given time t . Calculation of Tt may be performed based on the assumption that in the beginning, the compartment contained 100 persons who were going to leave that area. If we suppose that this emigration occurs linearly, so that this compartment would be emptied by a given time t_T , then Tt would equal $t_T/3$. Thus, if the first compartment would be emptied through a period of 20 years, Tt would amount to 6.6666 years. For the exponential elimination process, ($\exp(-at)$), Tt equals $1/a$.

In calculations performed within OPSIM2 procedure, the constant of elimi-

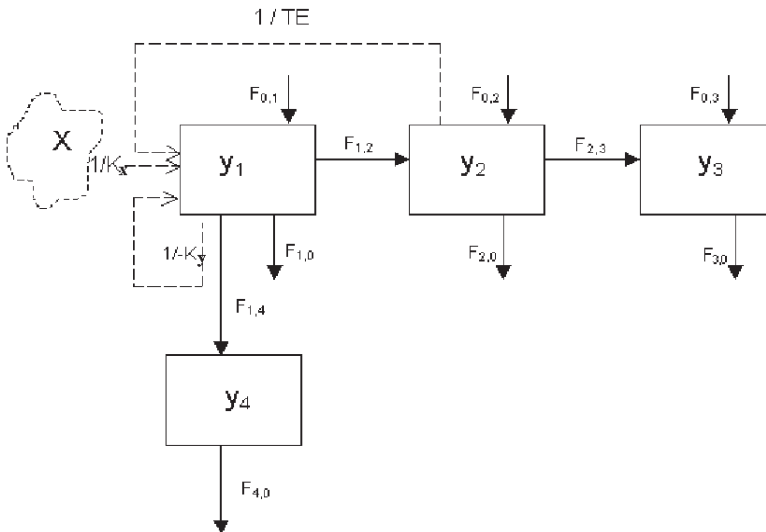


Fig. 2. Scheme of the dynamic model used for OPSIM simulation (DYNOPS).

nation from compartment »F«, may be approximated in the following terms: $1/Tt = -\ln(1 - tF)/t$. Accordingly, transfer flows $F_{1,2}$ and $F_{2,3}$ have a set value of 0.115, with the values of other flows being as follows: $F_{1,4} = 0.01$; $F_{1,0} = 0.005$; $F_{2,0} = 0.007$; $F_{3,0} = 0.04$; $F_{4,0} = 0.005$; $F_{1,4} = 0.01$. The latter flow designating emigration and/or inability to participate in the community's reproduction has been set provisionally.

This model is based on cybernetic control of input into the first compartment (input X_1), while in demographic model this input represents the number of children born within a one year period. The following constants influence the input into the first compartment: communication constants (environment system ($1/k_x$ i $1/k_y$)), reproductive constant $1/Te$. Control is established using the following three proportional feedback loops:

- a) Positive feedback between the state in the second compartment (y_2) and the speed of input into the first compartment ($1/Te$) y_2
- b) The speed of content input into the first compartment is additionally controlled by the environment (X) and the state within the first compartment (y_1), all of which is conducted using the following two feedback loops: positive ($1/k_x$) X and negative ($-1/k_y$) y_1 .

Mathematics of the DYNOPS model

Changes within every compartment in t interval, may be described using the following expression ²: $Y_{i,j} = Y_{i,j-1} (1 - t F_i) + t X_{i,j}^*$. Wherein, $X_{i,j}^*$ designates input into the »i« compartment either directly from the environment (X_i), or through immigration from other compartments: $F_{j,i} Y_j$. The netto flow through compartments »i« F_i is set by the following expression: $F_i = F_{i,j} - F_{0i}$ for $j = 0$ to N .

The same applies to:

$$Y_{i,j} / t = -F_i - Y_{1,j-1} + X_{i,j}^*$$

$$Y_{1,j} = Y_{1,j-1} (1 - tF_1) + X_{1,j-1}^* t$$

The following is also valid for:

$$X_{1,j} = (X_{1,j} - 1 + X_{1,j})/2$$

$$X_{1,j} = X/k_x - Y_{1,j} - 1/k_y + Y_{2,j} - 1/Te$$

$$Y_{2,j} = Y_{2,j-1}(1 - t F_2) + t F_{1,2} Y_{1,j-1}$$

$$Y_{2,j} / t = -F_2 - Y_{2,j-1} + F_{1,2} Y_{1,j-1}$$

$$Y_{3,j} / t = -F_3 - Y_{3,j-1} + F_{1,3} Y_{1,j-1}$$

$$Y_{4,j} / t = -F_4 - Y_{4,j-1} + F_{1,4} Y_{1,j-1}$$

When the value of t is small enough, the above stated expression may be represented using differential equations. Furthermore, it may be demonstrated that the following expression is valid for the first compartment (Y_1, t):

$$Y_{1,t} = Y_{1,0}(\exp(-ft) + (X/(k_x f))(1 - \exp(-ft)))$$

where

$$f = F_1 + 1/k_y - F_{12}/TeF_2$$

In certain specific conditions, allowing for the passage of time, the system acquires a state of dynamic equilibrium (i.e. steady state). In other words the overall contents of the system acquires steady values. According to the applied model, if a steady state is established, the relation of the environment and the contents of the first compartment ($Y_{1,ss}$) is as follows: $Y_{1,ss} = (X/k_x)/(F_1 + 1/k_y - F_{12}/TeF_2)$. In the steady state, the following applies to successive compartments: $Y_{2,ss} = Y_{1,ss} F_{12}/F_2$.

Results

Investigation of the basic characteristics of the model

The investigation of the basic characteristics of the model has been conducted with constant flows (F : $F_1 = 0.056$, $F_{12} = 0.05$ i $F_2 = 0.055$) and content quantity in the environment (X), and is based on changes in parameters influencing the input speed in the first compartment (input

X_1) – control constants Te and $k_x=k_y=K$. Values of the noted constants ranged between 1 and 100 in this investigation.

As depicted in Figure 3, there exists a field of relationship between constants K and Te , in which the steady state is not established (depicted with dots). In these conditions, a member of the $F12k_x/F2Te$ is greater than $F1k_x + k_x/k_y$. The results yielded in this investigation prove that the boundary for the existence of the steady state is given by the following relationship: $K_g = Te/(0.877 - 0.057Te)$. If the »real« K is greater than K_g , the system does not acquire the steady state, but remains in the state of constant progression. If the model is applied on demographic data ($F1 = 0.2$, $F12 = 0.15$, $F2 = 0.157$), the influence of control constants is approximately given by the following relationship: $Y1,ss/X = 2.639 + 0.159k_x + 0.018k_xTe - 0.33k_y$. These relationships show that there exist certain parameter values for which the model does not acquire the steady state.

Data obtained through investigation of changes in certain compartments show that the first compartment nears the steady state at fastest pace (greatest »f« value). Data on the inhabitants of the Bogomolje village on the island of Hvar¹², have been chosen to investigate appropri-

ateness of the DYNOPS model for application in demographic studies. Demographic and simulation data are depicted in Figure 4. It is clearly visible from Figure 4, that up until the year of 1910 there was an increase in population, which may be described by the following exponential function: $169(0.01347)^{(t - 1800)}$.

Demographic simulations have shown that during the period of population expansion the fastest growth (»f«) occurs in the youth compartment (Y_1). Based on these data, it is highly probable that in the period of up until the year of 1910, the youth (Y_1) has been reproducing with »f« = 0.0165. Since it holds that $f = F_1 + 1/k_y - F_{12}/TeF_2$ it is necessary to estimate the values of flows and $1/k_y$. Based on mean transit time estimates have been done for F_i : $F_1 = 0.12$; $F_2 = 0.11$; $F_3 = 0.15$. Furthermore, based on our own data for the island of Hvar⁴, Te equals: 7, $F_{12} = 0.1$, $F_{1,0} = 0.02$, $F_{23} = 0.103$, and $F_{20} = 0.007$.

Based on these data, the following relationship emerges: $0.0165 = 0.12 + 1/k_y - 0.1/0.11 \times 7$ out of which, using simple calculation we obtain the value of $k_y = 37.9$. In order to establish the initial set of conditions, we have used fitting data stating there were approximately 169 inhabit-

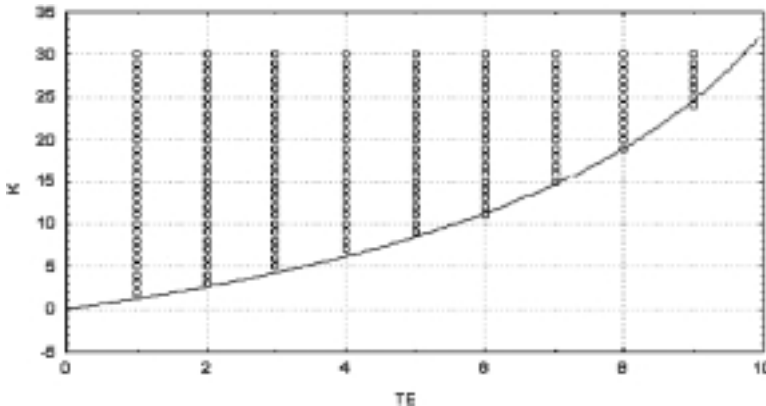


Fig. 3. The area of constant relationships in which the steady state is not acquired (dotted).

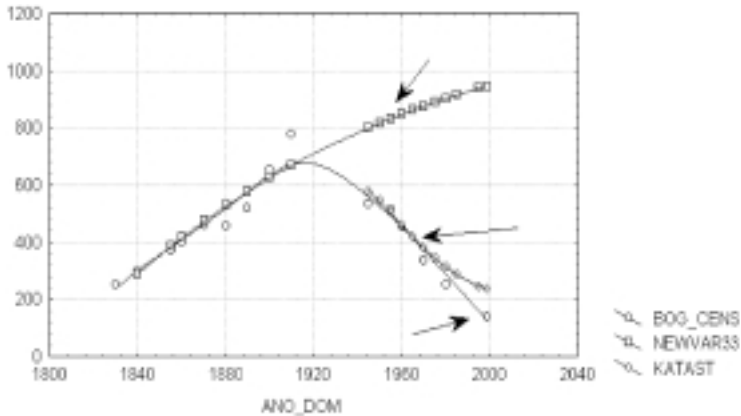


Fig. 4. Census of the Bogomolje village on the island of Hvar and DYNOPS simulation. The arrows (top-down direction) designate: a) Tendency towards the steady state ($N=1280$, $ANO_DOM=2170$), b) Prediction of a new steady state ($N=153$, $ANO_DOM=2020$), c) Real continued depopulation ($N=140$, $ANO_DOM=1999$).

ants in the year 1800, while this number increased to maximally 770 a hundred and ten years later (i.e., in 1910). Based on our presumption that at that time the population was close to reaching the steady state, and that at the beginning of the twentieth century the portion of youth in the overall population amounted to approximately 45%², we calculated that X/k_x equals approximately 5.7 ($X/k_x = 0.45 \cdot 770 \cdot 0.165$). We have performed several simulations with $F3 = 0.15$, and have successfully shown that given $X/k_x = 8.33$ the DYNOPS model provides satisfactory solutions for descriptions of population growth of the inhabitants of the Bogomolje village (Figure 4) up until the 1910s. In Figure 4, this simulation is depicted by a continuous curve up until the year 2000. If such progress would have continued until approximately 2170s, Bogomolje would have 1280 inhabitants. A disproportion (as would be expected) occurs in the period after 1910, i.e. when depopulation of the island of Hvar takes place. We have simulated this period along with the following changes: 1) $Te = 14$, $X/k_x = (\frac{1}{2}) 8.333$, $F30 = 0.075$. It is visible from Figure 4 that this simula-

tion coincides remarkably well with the census data up until approximately 1970. After that time, the real curve becomes even lower. In this depopulation part, the proportion of youth in the overall population has been overestimated to 31% by the model, while in reality, for the Republic of Croatia it amounts to only 26%³.

Discussion

As has been shown in previous sections, the OPSIM procedure is complementary with (auto) correlation statistical methods. Methodologically, this provides us with an opportunity to investigate the relationship between sets of variables using statistical methods. For example, we may group demographic data along the boundaries of age groups and investigate the resulting succession based on the following relationship: $Y_{ij} = Y_{ij-1} (1 - t F_i) + t X_{ij}^*$. This fact points to due apprehension while interpreting the results obtained using deterministic OPSIM model in terms of causes and consequences. It is our intention to establish a causal relationship between distinct parts of the system (i.e., the observed variables) by

means of GST and cybernetics. As opposed to this approach, statistical methods pretend to evaluate the significance of such relationships (i.e., correlation between a system's parts) and not their causality.

In this work, demographic data was put in cybernetic focus, since they a) are available, b) represent a complex reflection of anthropological events, and c) are dependent upon their environment. By investigating demography using the DYNOPS model, we are in fact investigating cybernetic relationship between chosen variables (feedback loops and input-output relations). However, when it comes to anthropology, these variables reflect complexly interwoven matrix of socio-cultural and bio-geographic factors. In order to survey potential scientific contributions of this work, it is necessary to explain: the chosen example of demography of the Bogomolje village, the meaning of model parameters, the concept of environment in cybernetic-anthropological context, the potential application of the DYNOPS model in anthropology, and finally, the modalities of such an application.

What does the chosen example of the demography of the Bogomolje village show, and the meaning of model parameters

Based on OPSIM mathematics, it has been shown that the calculated model parameters, with a given set of demographic changes, depend on the set network of flows. In numerous simulations we performed, it has been shown that the influence of the environment (X/k_x) increases with the decrease of the F_1 (longer time spent in the young age compartment). Thus, the reliability of the DYNOPS model depends on the reliability of flow estimate which further depends on the average time spent in a specific age compartment (T_t). In numerous other simulations (not shown in this paper since they

represent »technical« details of the investigation) it has been calculated that for the compartment of 0–20 years of age, the T_t ranges between 6.666 and 10 years. A part of the »technical« problem is also comprised of how to most adequately express linear extinction due to aging and maturation combined with exponential elimination due to illnesses, emigration and departure of (certain) individuals for schooling, using OPSIM compartment flows. However, these »technical« details are by no means the only problems we face. In the anthropological model, transfer into the reproductive compartment is culturally dependent, meaning that it had changed over the period of two centuries this model is attempting to survey through demography of the Bogomolje village. In the period of high mortality rate and low average age, the population probably entered marriages at an earlier age. Life expectancy has been significantly extended for children (due to vaccination and increases in hygiene standards) as well as for elderly individuals. The relationship F_{ij}/F_j is well set and regulates population age structures even for the simulation period after the year 1900^{2,3}. Somewhat unrealistic results were obtained for the »youth« compartment. In our previous research⁴ the T_e parameter for the island of Hvar has been calculated to equal 7, which would mean there would be 5–6 births per marriage although the number of children would be smaller due to high childhood mortality rates in the 19th century. By the increase of children survival rates, the number of births decreases (T_e increases), while the number and size of families decreases as well. There are indices that the average family on the island of Hvar in the 17th century consisted of around 8 members in the 1950s¹³ the average family in Bogomolje village counted approximately 3.85 members, while this number fell to 2.6 in 1981.

By the beginning of the 20th century, there is a marked depopulation of Dalmatian islands related to emigration during arid years, the downfall of sailboats, fishery, and wine production. Dalmatian islands reflect the events in their »neighborhood«: the Tripartite Croatia, Dalmatia, Italy, as well as creation and dissolution of two Yugoslav states. For example, an annual emigration rate of 1.4% has been noted in Italy¹³ in 1903 and 1913 respectively. In 1910 approximately 14% of Croatian population emigrated abroad, while somewhat lower emigration wave (5% of population) occurred in the period between 1921 and 1939¹⁴.

According to the DYNOPS model such »episodes« would be buffered if values of model parameters would not change, resulting in reestablishment of population levels predicted by the equifinality model over a prolonged period of time. Based on the DYNOPS model, the population would have to establish a steady state or, in other words, maintain its constant levels. In reality however (Figure 4), starting in 1910, a marked depopulation of the Bogomolje village as well as that of the rest of the island of Hvar^{4,14} occurs. Thus, a legitimate question is posed: which changes should be implemented in the DYNOPS model parameters in order to be able to simulate emigration. Emigration lowers the F12 transfer (for approximately 10%). It furthermore lowers and disproportions the number of males, which in turn induces lower birthrates ($T_e = 14$). However, model parameters set in the above stated manner did not yield adequate fitting with the available data so we had to intervene by lowering the environmental influence by half: from 8.33 to 8.33/2. Based on this information, we could deduce that the value of environmental influence onto a community also depends on the number of individuals that community consists of. This hypothesis, together with the finding that there exist

limited fields of constant relationships in which it is possible to establish equifinality (Figure 3) indicates that the equifinality concept is too simplistic when it comes to human communities. Furthermore, it should be noted that the environment of the Bogomolje¹⁴ village is not simply a minimized replica of the island of Hvar, since there are indices that a steady number of inhabitants is reached on the level of the island⁴, while this is not the case for the Bogomolje village (Figure 4). It is highly probable that in the existing socio-economic circumstances, three greater towns on the island act as attractors in this complex web of relationships⁴.

What is environment in cybernetic-anthropological sense

In ecological studies, the environment is defined and divided into two classes of factors: abiotic and biotic. In anthropology and cybernetics however, the term implies several specific surroundings such as: context, cosmos (universe), emergent meta-system, environment, field, meta-system, milieu, nature, situation, world, etc. (the noted list of expressions is not necessarily complete). Although we harbor no illusion of omni-applicability of the set DYNOPS model in all possible contexts of relationship between a system and its environment, we do however think this model could be used as a starting point for some more complex models. In these terms we would primarily concentrate on agent based modeling of emergent structures with anthropological implications. In the GST and cybernetics, environment refers to the surroundings out of which a system has been singled out. Since a system may be organized through a flow of important information, the Cosmos out of which this system has been singled out does not necessarily have to be uniform with the system. In anthropology, human beings are set aga-

inst nature and/or culture, so that changes in gene frequencies or socio-cultural characteristics defining a certain community, occur as consequences of adaptation to changing conditions in the environment^{15,16}. In order to illustrate the above stated notion, we will use examples from daily papers.

In 1976, the community of Selca on the island of Brač alone produced 60 wagons of Maraska cherries, while today the overall production of Maraska cherries in the Republic of Croatia, does not reach that amount. At the beginning of the 20th century, there were 30 million olive trees in Dalmatia, today only 3 million remain. A similar drop in production has been observed in other traditional Mediterranean cultures: figs, grapes, pyrethrum and carob-trees. The above stated data indicate that the DYNOPS model could be applied in investigation of the relationship between depopulation and a drop in biological and anthropological variability of the environment. Furthermore, we are of the opinion that the described model could also be used to study the influence on other environments, such as for example the flow of ideas or the influence of pollution. Environment as an anthropological determinant is a meta-systemic formation: an individual is set against his/her kin, certain families (surnames) are set against settlements they inhabit, and the settlements are in turn exposed to the influence of neighboring cities and/or entire region(s). This influence may be informational and communicational (exchange of goods), while even the influence of emigration cannot be neglected today. In these various possible environments and »communications«, the control constants k_x i k_y may be of various dimensions (dimensionality), while com-

partments do not necessarily have to be of the same quality since they may involve correlation variables.

A drawback of the DYNOPS model is that it places the environment in an unchangeable category, while in reality, the environment necessarily changes in a multitude of its interactions with various agents. However, the context of environmental unchangeableness of this model allows for evaluation of »autopoieticity« of the described system. The size of a system set by the environment equals $(X/k_x)/(F1 + k_y)$, so that in the example of the Bogomolje village, if the steady state had been established, the environmental portion would equal $8.333/1.46385 = 57$ young men, while with reproduction alone, there would be 505 young men in the village; therefore autopoieticity^{17***}, of the village is approximately 90% (57/505). In the time of depopulation, this index drops to 60%. It should be kept in mind that cybernetics is used in epistemological sense as well. We have been animated to pursue this line of thought on model application by the simple fact that cybernetic concepts are being used in epistemological sense, so that in anthropology we are faced with evaluations and explications of phenomena from observer-dependent positions. Although we do not reject this approach, we do however think that cybernetics should not only be used to explicate but also predict (and eventually correct) undesired development of certain local communities. In that respect, it should be necessary to develop numerous models with various platforms, test them on as large as possible number of examples, and finally evaluate anthropological meaning of specific parameters and models in this manner.

*** *Autopoieticity*: from *autopoiesis* – “the theoretical construct definitive of the manner of operation of that class of systems that includes living systems. This term, combined from the Greek *auto-* (self) and *poiesis* (creation/production), was coined by Maturana in (approximately) 1972” *Autopoieticity* would thus closely relate to the ability of a system to perform autopoietic tasks of self-creation or self-production.

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INTERAKCIJA S OKOLIŠEM: ANTROPOLOŠKO-KIBERNETIČKI MODEL

SAŽETAK

Kibernetika se poglavito bavi prijenosom informacija kroz, i reakcijama sustava. Cilj istraživanja bio je istražiti model dinamike interakcije antropološkog sistema s okolišem. U tu svrhu primijenjen je dinamički (*equifinality*) model koji stremi uspostavi postojanog stanja '*steady state*' neovisno o početnim uvjetima. Svrha je istraživanja bila istražiti antropološku primjenu ovakvog koncepta koristeći se OPSIM postupkom. Također je korišten i DYNOPS model zadan s četiri odjeljka i okolišem. Model je primijenjen na podatke popisa stanovništva za selo Bogomolje na otoku Hvaru (R. H.). Brojne izvršene simulacije pokazale su da utjecaj okoliša raste proporcionalno smanjenju vremena provedenog u odjeljku mladih ljudi. Nedostatak DYNOPS modela je što okoliš stavlja u nepromjenjivu kategoriju dok za mnoge odnose interakcije s okolišem on se u toj interakciji nužno mijenja. Naposljetku, kibernetika se ne bi trebala koristiti samo u svrhu objašnjavanja, već i predviđanja i ispravljanja neželjenih razvojnih tendencija unutar društvenih zajednica.