Modern hydrobiology, mainly, is based on conception, which may be named Conception of unicity of ecosystem stable state (CUESS): Mature ecosystems are stable and in dynamic equilibrium. Ecosystem state fluctuates around alone point of a global equilibrium (balance of energy, matter, diversity); smooth changes prevail. Really every ecosystem as well as every complicated integrated system has several alternative steady states (Scheffer, 2001; Dent et al., 2002). Data that communities, ecosystems and populations can exist more, than in one steady state, began to accumulate, since beginning 20th Century. The Concept of multiplicity of ecosystem alternative stable states (CMEASS) as a new ecological paradigm is been developing now (Walker et al., 2004). In the emerging paradigm dynamics and evolution of ecological systems are characterized by two stages - the coherent evolution/dynamics and incoherent (Krasilov, 2001). Each of the stages in turn includes two stages (Walker et al., 2004). C. Holling (2001) describes patterns and processes over time in many change ecosystems, using four-phase model - the adaptive cycle. During coherent stage a system realizes a smooth adaptation to the changing environment within an existing norm of reaction; during incoherent stage – there are destabilization of system and its transformation through tipping point in a new state. Tipping point (TP) is a critical point in system transit from one steady state to alternative one – no reverse way point. CUESS is applicable to analyze ecosystem dynamics/evolution in coherent stage, but it doesn’t mean that we can’t make any prediction.

CMEASS seems is fairly well developed now. However, despite this, it is very little used in studies and management of saline lake ecosystems. What are causes of this? Some reasons are problems of selection and identification of the discrete alternative stable states of real lake ecosystems as well as prediction of tipping points in their dynamics. In “normal” environment a structure and functioning of biota is determined by system of biotic interrelations at first, but in extreme environment - by abiotic factors at first. Therefore the structure of ecosystems, existing in an extreme and high changeable environment, is more responsive on the changes of abiotic/climatic factors; alternative stable states are distinguished more clearly for them. Hypersaline lake ecosystems have considerable environmental, social and economic value. They also have a scientific value, including for developing of CMEASS. Our long-term study of the Crimean hypersaline lakes gave us possibility to identify the alternative steady states in dynamics of these lake ecosystems.

Situated in the northern Black Sea, Crimea is the largest (nearly 26.5 thousands km²) Black Sea peninsula. There are 50 comparatively large and numerous small hypersaline lakes in Crimea. Most part of long-term results (2000-2013) is published (Shadrin, 2009; etc.). Here I try to look on these results through CMEASS.

The energy input into the ecosystem can be carried out by various ecological and physiological groups of primary producers, which use the three mechanisms of phototrophy (bacteriorhodopsin pumps, anoxygenic photosynthesis and
oxygenic photosynthesis) and a number of mechanisms of chemolithotrophy. I think that structure of energy input in ecosystem is one of main characteristics for separation and identification of different stable states of lake ecosystems. In different alternative states the different ecological-physiological groups of phototrophic primary producers play leading role. Several stable states were identified: 1. Arheia (Halobacteria) plankton, 2. Algae – anoxygenic bacteria plankton, 3. Algae – cyanobacteria plankton, 4. Green algae bottom mat, 5. Green algae (Cladophora) flouting mat, 6. Flouting mat with purple bacteria domination, 7. Purple bacteria bottom mat, 8. Cyanobacteria film under salt crust, 9. Flowering plant Ruphipia community, 10. Bottom algae-bacterial film.

More detailed information on some above-mentioned primary producing systems in Crimean lakes is given in our published papers (Prazukin et al., 2008; Samylina et al., 2010). At first view we can conclude that salinity is main alone driving factor. Critical salinities are the TPs. Passing through TP, a lake ecosystem needs to ‘jump’ into a new alternative state. There is no alone driving factor. When we tried to identify the TPs we found that value of salinity as TP relates with direction of changes. In different direction of salinity change – increasing or decreasing - in lake there are distinguished values of TP. It’s effect of hysteresis; ecosystem has, in certain sense, memory (Shadrin, 2013). One element of this memory is “sleeping” biodiversity - the resting stage of various organisms; which are present in the most species-inhabitants of hypersaline waters. Ecosystem “memory” as well as ‘irregularities rule the world’ principle makes impossible a strong forecast of ecosystem transit from one stable state to another.

All above are more theoretical issues but this has a strong application to development of salinology as ‘a branch of applied science focused on the study of the chemistry, physics and biology of saline lake systems. The basic task of salinology is to study and explore the features of saline lakes, to provide a scientific and technological basis for the coordination between mankind and saline lakes, to promote the scientific management and rational utilization of saline lake, and to contribute to the sustainable development of saline lake agriculture, mining and tourism’ (Zheng, 2001).

Scientific background must be sound and reflect real peculiarities of salt lake ecosystems; it must be based on CMEASS. CUESS and CMEASS give us different views on possibilities, tasks and institutional organization of environmental management, including for saline lakes (Shadrin et al., 2012). Main goal of traditional environmental management: we should strive to accurately predict the response of the system on our impact and to develop an optimal strategy for ecosystem management and strongly use it. The objectives of management based on CMEASS should be: foresight when system to reach TP, estimate of transition probabilities in one of the new alternative stable states, to identify the spectrum of possible alternative states, developing a set of possible socio-economic adaptation strategies in the new environment and their flexible use. These two strategies of environmental management are complementary, because one of them is efficient in terms of coherent dynamics, and another - in terms of incoherent dynamics. Overall goal is to anticipate and, if possible, to prevent unwanted changes, if it is not possible to prevent, then to be prepared for a livelihood in the new definitely not predictable conditions. In this regard, the right choice of management strategy depends on correct estimation of the speed of the system moving to TP and the distance to it. In different stable states the lake ecosystems have different resource potential and different possibilities to use it by humans. Sustainable long-term management of salt lakes requires a set of alternative strategies for environmental management; we need the timely switch from one strategy to the alternative one. Transit of ecosystems into some new alternative states is not only a loss for humans, but also new opportunities. We need to be optimistic and do not afraid of the new unpredictable stable states. Losses will be offset by new opportunities... if we want to see the new opportunities.

References