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THE CLIMATE CHANGE IMPACT, LAND USE CHANGE AND HYDRO-ECOLOGICAL DISTURBANCES ON AVIAN DIVERSITY IN LAKE URMIA AND ITS BASIN IN IRAN

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Abstract: *Lake Urmia was home to more than 200 species of birds including the migratory species like; flamingos, pelicans, spoonbills, ibises, storks, shelducks, avocets, stilts, and gulls. Due to present high salinity the lake contains simple ecological food chain. The present study considers the impacts of climate change and hydro-ecological disturbances upon lake and its avian diversity. With present condition and further degradation, it is quite obvious Lake Urmia will no longer support biological diversity and landscape integrity.*

Key words*:* Lake Urmia, Artemia Urmiana, Birds Diversity, Climate Change

Introduction

The Lake Urmia is a vast hyper-saline lake with total dissolved salts reaching 200 g/l, located in north-western side of Iran between west and east Azerbaijan provinces (Agh et al., 2008; Alipour, 2006). The lake was declared wetland of international importance by the Ramsar Convention in 1971, and designated a UNESCO Biosphere Reserve in 1976 (Hogan, 2011). The lake itself is home to a unique brine shrimp species, *Artemia urmiana*, and along with the surrounding islands and upland habitats, supports diverse species of reptiles, birds, amphibians and mammals. The lake has dramatically decreased in volume over the past two decades, further concentrating salts content in the lake, raising salinity to more than 300 g/L. Aquatic biodiversity is limited by the lake's salinity and Lake Urmia does not support any fish or mollusk species and no plants other than phytoplankton within the lake (Dahesht et al., 2010; Eimanifar and Mohebbi, 2007; E. J. Brill, 1913-1936). The most significant aquatic biota in the lake is a brine shrimp species, *Artemia urmiana.* This macro-zooplankton species has several adaptation capacity that help organism to survive in an extreme environment and it is the key link in the lake's food chain, consuming algae and in turn being consumed by several bird species.

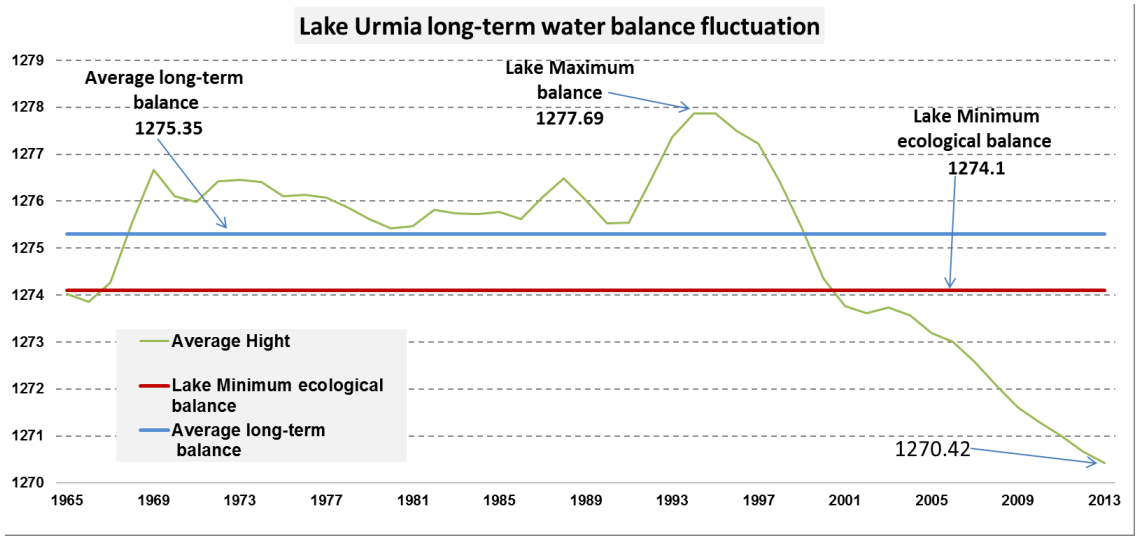
Due to construction of more than 40 dams on 14 major rivers, drought and unsustainable agricultural practices, the level of water in lake has dropped to such an extent that the salinity of lake has risen to a range of 300-500 gr/liter, and major areas of the lakebed has been completely desiccated. Lake Urmia is home to more than 200 species of

birds, 40 species of reptiles, 7 species of amphibians and 27 species of mammals (Ghaheri et al.,1999), including the Persian fallow deer (Dama dama mesopotamica), a rare ruminant species belonging to the family Cervidae (Golabian, 2010). Due to increased salinity of lake water, the viability of lake to host thousands of migratory bird species including the large flamingo populations has drastically decreased. The lake is surrounded by more than a hundred small rocky islands which serve as touching and resting station during the wild birds migration including: flamingos, pelicans, spoonbills, ibises, storks, shelducks, avocets, stilts, and gulls (Bird Table). The natural vegetation has largely been lost. Around the lake shore, salt flats stretch for several hundred to thousand meters. Beyond this, low vegetation dominated by Chenopodiaceae grows, and there are brackish marshes with typical communities of rushes Juncus spp., and reeds Phragmites communis. Because of very high salinity, the lake no longer sustains aquatic community. Beside, Lake Urmia is considered a significant natural habitat of Artemia, which serve as food source for the migratory birds such as flamingos and others (Roger, 2003). Because of high salinity and hydro-ecological disturbances the existence or extinction of Artemia Urmiana from lake is of much debate among concerned authorities (Mackey, 2011).

Main problems facing Lake Urmia

The Lake has faced intense pressure during the last one decade and is currently in a state of ecological crisis with major impacts on biodiversity and socio-economic conditions of people living in surrounding area. The water level has continuously decreased and salt concentration increased. Also climate change causing serious impacts, especially on diversity of migratory birds, should be addressed with obligation. Based on 2013 (UNDP-DoE) survey, the lake water capacity comprises:

- Water level 1270.6 (Av. 1275.5, Max. 1278.4) amsl\
- Area 1628.7 vs. 5,000-6,000 km2 in normal condition
- Water volume 1.85 bcm vs. 32 bcm in normal condition



Source: UNDP, DoE

Proposed Action

- Expand lake management scope, to include social goal for the desired future;
- Identify and define partners (institutional and non-governmental) and their roles within the lake ecosystem;
- Consult all stakeholders and beneficiary early in the planning process;
- Improve communication with local community; and,
- Recognize various interests, including biodiversity conservation among partners;

Results and Discussion

Reduced water level of the lake has already concentrated the existing salts to 300-500 g/l in many locations, with remarkable impact on ecological conditions. Sodium Chloride concentrations higher than 320 g/l is believed to be fatal to the lake's brine shrimp. Optimal conditions for Artemia urmiana appear to be at salt concentrations well under 200 g/l and as

salinity rise much above this level, there is a measured negative impact on growth rate, reproduction and egg laying capacity (Micklin, 2007; Ramsar, 1997). Based on in situ observations of the brine shrimp populations under varying salinities in Lake Urmia, it has been suggested that a concentration of 240 g/l or less would be required to sustain a viable population. The lake's brine shrimp are the sole link between the primary production of the lake's algae and the diverse migratory bird population which feeds on this species (Rezvantalab and Amrollahi, 2011). Because the brine shrimp occupy this crucial link in the ecosystem their extinction would likely create disappearance of Lake Urmia's migratory bird populations and affect the entire ecosystem's sustainability (Yakhchali and Khalili, 2003). Climate change is one of the greatest threats to the environment, causing serious impact to the lake biological diversity. As lake levels decline, the exposed lakebed is left with a covering of salts, primarily Sodium Chloride, making a great salty desert on much of the 400 km2 of lost surface area. These salt flats will not support agriculture and inhibit growth of most natural vegetation. The salts are also susceptible to blowing and likely will create salt-storms like the ones that have resulted from the drying of the Aral Sea, located 1,200 km to the northeast of Lake Urmia, impacting migratory birds' navigation capabilities (Yakhchali and Khalili, 2003). Blowing salts from the Aral Sea have been linked to vegetation mortality in some cases or more frequently, reduced vegetation growth, reduced crop yields, ill effects on wild and domestic animals, respiratory illness, eye problems, and throat and esophageal cancer (Zarghami, 2011). Moreover, the result based on field observation by telescope indicate, due to the Lake Urmia degradation and ecological collapse, the avian diversity and population size, especially the migratory visiting birds immensely declined.

BASED ON FIELD MEASUREMENT
Main Social and biological threats:

- Emergence of sand dunes phenomenon;
- Occurrence of salt dust;
- Quality of life reduction in the basin;
- Wildlife exit from islands and invasive species enter to islands;
- Mass loss of native Artemia urmiana species;
- Drying effect of lake to the climate of area;
- Lose of wildlife food in islands, and
- Reduction in the diversity of migratory birds

Programs in urgent need:

- Cooperation with all concerned sectors, including local community, backstop by legislative and regulatory mechanism;
- Three levels management tier at national, provincial and local, participating and coordinating well with each other to mobilize financial, technical and human resources;
- Surveillance program development based on continuous monitoring and assessment strategy;
- Sustainable agricultural practices based on feasible irrigational capacity;
- Zoning and delineation development;
- Public encouragement to participate in conservation activities; and,
- Prohibition of any new water allocation which will enhance further stress.

Some Quick Solutions include:

- Facilitate the appropriate transfer of water to the lake;
- Close-down unlicensed deep wells by community participation and willingness;
- Remove levees from rivers leading to the lake;
- Prevent further development of agricultural field in the watershed areas;
- Practice appropriate crop cultivation pattern with minimum irrigation requirement; and,
- Prevent further dam construction and stop completing current dam construction project, and possibly release appropriate water from existing dam to the lake.

The way forward and challenges:

- Changing development pattern in the basin;
- Work and practice based on a plan for the whole basin by all stakeholders;
- Strengthening local rights and achieving wetland conservation goals;
- Changing water consumption pattern in all sectors specially in agriculture;
- Adopting budget allocation to address sustainable development goals;
- Implementing of water share pattern among provinces in the basin;
- Social mobilization for saving the lake and changing livelihood patterns in the basin; and,
- Emphasizing bio-ecological-based approaches.

Conclusion

With present condition and further degradation, Lake Urmia will no longer support biological diversity, landscape integrity, climate regulation, pollution and sediment retention, groundwater recharge, fishery, migratory birds and bird's habitat, medicinal herbs, ecotourism, recreation, cultural heritage and so on. Both Sectoral and ecological boundaries must be examined to identify legal and regulatory mandates, potential interest, and possible partners. Lake Urmia shared management provinces may examine their goals and objectives in terms of the larger environment, including:

- Physical and chemical settings supportive of wetland natural aquatic resource abundance and distribution;
- Aquatic community structure (species, age/size distribution) resulting in robust and sustainable resources; and,
- Coordinate in inter and intra-sectoral research, data collection, and use;

Wetland management planning process should be inclusive, having as an objective the health of the ecosystem and focusing on local livelihoods and human sustainable development. Moreover, Bird Table should be considered as an indicator for collaborative action on climate change with respect to biodiversity and socio-ecological conservation in the crucial years ahead.

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