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"Effects of Salinity on Plantae and Estuary animals in Arid and Semi-arid Regions"

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Introduction

The measure of all the salts dissolved in water is called Salinity. Water in estuaries is a mix of fresh water and ocean water. The salinity in an open ocean is greater than in most estuaries. The salt in the ocean is mostly made up of the elements Sodium (Na) and Chlorine (Cl). With these components, together they make up 99.4% of the salt in the ocean. Marine salinity levels are influenced by a number of factors including rainfall, evaporation, inflow of river water, wind, and melting of glaciers. Salinity can have a great impact on the type of organisms that live in a body of water, as examined in the Case Studies section below. Additionally, salinity plays a critical role in the water cycle and ocean circulation. With an occurring increase of saline in the water, water salinity can greatly affect the ecosystems, plantae, and estuary animals.

This term paper includes related literatures tackling the topic of Salinity. These studies serve as a reference for this research. The synthesis of the art, serves as a guide as a breakdown for the ideas taken for this paper.

Review of Related Studies

According to the study entitled “Salinization: A major threat to water resources in the arid and semi-arid regions of the world” by W.D Williams [1] salinization has significant economic, social and environmental impacts. This study talks about the salinity of many large natural salt lakes in drylands are rising as waters is diverted from their inflows for irrigation and other uses. The rising of saline groundwaters causes the salinization of some fresh waters. There are about 400 million people that lives in a arid and semi-arid regions. Due to this heavy population, a shortage may occur for supply because waters in drylands are under increasing human pressures, and many are threatened by rising salinities. In some regions, increasing climatic aridity may be a cause of salinization.

This study entitled “Groundwater–surface water interactions in a large semi-arid floodplain: implications for salinity management” by Sébastien Lamontagne, Fred W. Leaney, and Andrew L. Herczeg [2] talks about the exchange of surface waters between the Murray River and floodplains resulted from flow regulation and water diversion for irrigation. The origin of groundwater is principally bank recharge in the riparian zone and a combination of diffuse rainfall recharge and localized floodwater recharge elsewhere in the floodplain was suggested by the data of environment tracers. To understand the spatial variability in the hydraulic connection with the river channel and in vertical recharge following inundations will be critical to design effective salinity remediation strategies for large semi-arid floodplains.

From the study entitled “Water resources, salinity and salt yields of the rivers of the Bolivian Amazon” by Michel-Alain Roche and Carlos Fernandez Jauregui [3] talks about the water resources, salinity, and salt yields of the upper basins of Madera River. One of the biggest rivers in the world, is the Madera River. Many types of water, classified according to their ionic compositions, have been characterized in the Andes, the Amazon Plain, and in the main drainage axis. The low chloride and sodium contents of the water in the plain confirms the recycling of water vapor in the Amazon Basin. The contribution of the Upper Madera River to the Amazon River is 9.7% of the water and 10.9% of ionic load.

According to the study of Holger R. Maier and Graeme C. Dandy, entitled “Input determination for neural network models in water resources applications. Part

2. Case study: forecasting salinity in a river" [4] The first method utilises a measure of dependence known as the partial mutual information (PMI) criterion to select significant model inputs. The second method utilises a self-organising map(SOM) to remove redundant input variables, and a hybrid genetic algorithm (GA) and general regression neural network (GRNN) to select the inputs that have a significant influence on the model's forecast. In the first paper, both methods were applied to synthetic data sets and were shown to lead to a set of appropriate ANN model inputs. The two proposed methods were found to lead to more parsimonious models with a lower forecasting error than the models developed using the methods from previous studies.

A study entitled "Effects of salinity on river, stream, and wetland ecosystems in Victoria, Australia" written by Barry T. Hart, Paul Bailey, Rick Edwards, Kent Hortle, Kim James Andrew McMahon, Charles Meredith, and Kerrie Swadling [5]. It talks about on how salinity affects the river, stream, and wetland ecosystems. Salinity is a growing problem in the multiple parts of the world. Dryland salinity and salinity in irrigation are a serious problems in Australia. In order to control the latter, the options to involve pumping the groundwater to lower the water table. Although this process leaves a saline wastewater to be disposed, probably into the wetlands or local streams. This study mentioned about a previous review by the authors covered the lethal and sub-lethal effects of salinity on individual species within the following groups of aquatic organisms. On that review concentrated in an Australian information, it is argued it will be more typical of the effects occurring over a large part of the world than data from the better watered areas of North America and Europe. They used these data on individual species to determine the possible effects of saline wastewater discharges on aquatic ecosystems, lowland rivers, streams, and wetlands. They also developed a set of guidelines for assessing possible biological effects in salt-affected rivers, streams or wetlands.

According to the study of D. L Nielsen, M. A. Brock, G. N. Rees and D. S. Baldwin, entitled “Effects of increasing salinity on freshwater ecosystems in Australia” [6], salt is natural component of Australian Landscape which a group of biotas inhabiting rivers and wetlands are adapted. The concentration of salts in wetlands and riverine pools resulted from under natural flow conditions periods of low flow. The organisms present on these systems survive these salinities by tolerance or avoidance. Salinity is being a big threat in the freshwater ecosystems in Australia because of the rising of saline groundwater and modification of water regime reducing the frequency of high-low (flushing) events, resulting in an accumulation of salt. Salinization can lead in the physical environment which will affect ecosystem processes. This study talks about how salinity affects the physical and biotic components of aquatic ecosystems and explores the needs for information on how structure and function of aquatic ecosystems change with increasing salinity.

From the study “Tolerance of Freshwater Invertebrates to Changes in Water Salinity” written by N. A. Berezina[7], tolerance to an increase or decrease in water salinity was studied in experiments with some species of freshwater turbellarians, oligochaetes, leeches, mollusks, crustaceans, caddis flies, biting midges, and chironomids from water bodies of the Upper Volga basin. Insect larvae and crustaceans were most tolerant, whereas mollusks and leeches were sensitive to a decrease in water salinity. Specific responses of the studied species to changes in water salinity were revealed.

From the chapter of a book from A Vengosh, Duke University, Durham, NC, USA [8], entitled “Salinization and Saline Environments”

One of the most conspicuous phenomena of water-quality degradation, particularly in arid and semi-arid zones, is salinization of water and soil resources. Salinization is a long-term phenomenon, and during the last century many aquifers and river basins have become unsuitable for human consumption owing to high levels of salinity. Moreover, every year a large fraction of agricultural land is salinized and becomes unusable. Salinization is a global environmental phenomenon that affects many different aspects of our life (Williams, 2001a, b): changing the chemical composition of natural water resources (lakes, rivers, and groundwater), degrading the quality of water supply to the domestic and agriculture sectors, contribution to loss of biodiversity, taxonomic replacement by halotolerant species (Williams, 2001a, b), loss of fertile soil, collapse of agricultural and fishery industries, changing of local climatic conditions, and creating severe health problems (e.g., the Aral Basin). In Australia, accelerating soil salinization has become a massive environmental and economic disaster. Hence, the salinity level of groundwater is one of the limiting factors that determine the suitability of water for a variety of applications. The salinity problem is a global phenomenon but it is more severe in water-scarce areas, such as arid and semi-arid zones. The increasing demand for water has created tremendous pressures on water resources that have resulted in lowering water level and increasing salinization.

The Effect of Salinity on Tropical Ocean Models

By Neill S. Cooper [8]

Abstract

The effect of horizontal salinity gradients on the tropical ocean circulation has not previously been evaluated. It is shown that there are noticeable differences between the dynamic height field calculated with and without the inclusion of salinity variations. Hence salinity has a significant contribution to the geostrophic velocity field. This conclusion is illustrated by running two identical Indian Ocean models:. one initialized using a climatological salinity field while the other has no horizontal salinity gradients.. Further experiments using the same model for data updating studies showed that the absence of salinity data

greatly reduces the usefulness of temperature data. It is concluded that for an accurate simulation of the tropical ocean the salinity field needs to be included. It also mentioned here in this article on organisms react differently in changes in salinity.

Salinity by Bayville [9]

According to Bayville , Salinity is the amount of salt in water. Most of the salt in the Bay and in most water is sodium chloride. Other salts are potassium, calcium, sulfate, and magnesium chlorides. This also talks about on how salinity can be measured. One method of measuring salinity is using a conductivity meter. This meter uses the fact that the higher the salt content of water, the more easily an electric current passes through it (the better it conducts electricity). This article also tackled abut how salinity affected the Chesapeake Bay. Organisms living in the Chesapeake Bay are most successful at certain salinity ranges,which, for the most part, determine where in the Bay they live. Sudden changes in salinity may kill some organisms and can weaken others causing them to be more susceptible to diseases and other environmental stresses. Measuring salinity allows scientists to determine if it is likely that a specific organism will survive in the area where the measurement is taken.

All about salinity by Environment NSW [10]

According to this article it defines that salinity is the presence of salt in the land surface, in soil or rocks, or dissolved in water in our rivers or groundwater. When wind and rain weather rocks that contain salt, or carry salt from the ocean, then salt is left in the landscape. Salt has also been deposited in places that were under the sea in prehistoric times. Salinity can develop naturally, but where human intervention has disturbed natural ecosystems and changed the hydrology of the landscape, the movement of salts into rivers and onto land has been accelerated. It also talked about the different types of Salinity, such as dryland salinity, industrial salinity, river salinity, and irrigation salinity.

From the study “Drainage water salinity of tubewells and pipe drains: A case study from Pakistan” written by JKellenersa and M.RChaudhryb [11], it states that drainage water salinity of the tubewells and the pipe drains remained approximately constant with time. This was attributed to the deep, highly conductive, unconfined aquifer underlying the area, which facilitates lateral groundwater inflow into the drained areas. Tubewells have an inferior drainage water quality because they attract water from greater depths, where the water is more saline.

From the study conducted H. M. Rasel, M. R. Hasan2, B. Ahmed1 and M. S. U. Miah [12] with the title of “Investigation of soil and water salinity, its effect on crop production and adaptation strategy” , the coastal areas of Bangladesh cover more than 30% of the cultivable lands of the country. About 53% of the coastal areas are affected by salinity. Agricultural land use in these areas is very poor, which is much lower than a country’s average cropping intensity. Salinity causes unfavorable environment and hydrological situation that restrict the normal crop production throughout the year. The factors which contribute significantly to the development of saline soil are, tidal flooding during wet season (June to October), direct inundation by saline water, and upward or lateral movement of saline ground water during dry season (November to May). The severity of salinity problem in Bangladesh increases with the desiccation of the soil. It affects crops depending on degree of salinity at the critical stages of growth, which reduces yield and in severe cases total yield is lost. Therefore, it is very important to investigate the present scenario of soil and water affected by salinity on crop production of the study area. It has effect on crop yield in dry season due to increased salinity level.

The study “Salinity and Faunal Distribution in the Pocasset River” by H. L. Sanders, P. C. Mangelsdorf Jr., and G. R. Hampson [13] the summer of 1963 and the spring of 1965, a study was made comparing the subtidal sediment salinities with those of the immediately overlying water in a small estuary north of Woods Hole, the Pocasset River, and relating these findings to the distribution of the estuarine fauna.

This salinity regime has a marked effect on the distribution of the benthic fauna. The epifauna, subjected to the extreme salinity fluctuation and rapid and extreme salinity changes, is poorly represented, particularly in the upper part of the estuary. The infauna, living under much more stable salinity conditions, make up the vast majority of the fauna. The periodic short-term fluctuations in the water salinity stabilize the sediment salinities and subject the infauna to less physiological stress than that imposed on the epifauna.

Animals collected from the transitional zone were exposed in the laboratory to low and high salinity water obtained from the same locality at low and high tide, respectively, and to a control salinity duplicating the average sediment salinity of the zone.

According to the authors (Rhoades, J. D. ; Loveday, J. Rhoades, J. D. ; Loveday, J.) [14] of the study entitled "Salinity in irrigated agriculture" tackles various concepts involved in defining and diagnosing soil and water salinity and the associated problem of sodicity, and outlines the effects of salts on soils and plants, and the processes influencing salinity and sodicity within the soil-plant-water system. This material provides the background needed for the discussions that follow of practices to control salinity in irrigated lands and to reclaim salt-affected soils.

The article “Origin of salinity and impacts on fresh groundwater resources: Optimisation of isotopic techniques” from Results of a 2000-2004 Coordinated Research Project [15]. It defines salinization is a global environmental problem that affects various aspects of our life such as changing the chemical composition of natural water resources regrading the quality of agricultural and domestic water supplies, contributing to loss of biodiversity, loss of fertile soil, collapse of agricultural and fishery industries, and creating severe health problems. Water salinization is a global problem but it is more severe in water-scarce areas, such as aridand semi-arid zones, where groundwater is the primary source of water. The continuous growth on the demand of groundwater has created tremendous pressure on the use of the resources resulting in lowering of water levels and an increase in salinization

From the study entitled “Salinity and evaporation in the River Murray Basin, Australia” bH.J.Simpson and A.L.Herczegy [16], it talks about the River Murray discharges only 4% of annual precipitation delivered to the Murray Basin. The additional salt flux out of the River Murray was apparently derived primarily from saline ground water plus mobilization by irrigation drainage of salt stored within the unsaturated zone. Most of this heavy isotope enrichment was the result of evaporation from reservoir and river surfaces plus inflow of irrigation drainage water. The trend in deuterium values along the river axis suggests that a large component of the chloride increase in the middle third of the river was derived from irrigation drainage whereas the further increase of chloride in the downstream third of the Murray was derived primarily from influx of saline ground waters. Evaporative enrichment appears to play a major role in the seasonal and geographical trends of stable isotope composition in the River Murray. The total deuterium enrichment observed indicates that integrated evaporation losses in the basin are similar in magnitude to transpiration losses during the months of intensive irrigation.

According from the study entitled “Salinity variations in North Sea formation waters: implications for large-scale fluid movements” by KnutBjørlykke and

KjetilGran [17], Sodium chloride is the major salt dissolved in formation waters, even at a considerable distance away from any evaporites. Chloride anions are not consumed to any significant extent by diagenetic reactions outside the salt deposits. Chloride ions are therefore preserved in the pore waters, and the distribution of pore water salinities in sedimentary basins may help to constrain pore water flow and the transport of dissolved species of silica and carbonate minerals. In the North Sea Basin and Haltenbanken (mid-Norway), salinity gradients can be inferred from formation water samples. Measurements of pore water salinity from wireline logs are less accurate than formation water samples, but have the advantage that a much larger database can be obtained. In the southern part of the Norwegian North Sea and Haltenbanken, there is a clear trend towards higher salinities with greater burial depth. There is a pronounced salinity increase in the 500 m of section closest to the evaporites. In the northern North Sea, where underlying evaporites are not known, there is only a slight increase in the measured salinities with depth. This pattern of salinity distribution in the pore water precludes large-scale convection of the pore water during diagenesis. It also indicates limited compaction-driven flow. Log-derived salinity data from the North Sea suggest that the pore waters in Upper Jurassic and Tertiary reservoirs are generally more saline than those of Middle and Lower Jurassic reservoirs at the same depth. The constraints on pore water flow that can be deduced from salinity variations puts severe limitations on the mechanisms of transport of dissolved solids in sedimentary basins and thus also on aspects of diagenetic models.

From the study entitled "Salinity reduction and energy conservation in direct and indirect potable water reuse" by Arjun K.VenkatesanSajjadAhmadWalterJohnsonJacimaria R.Batista [18], it talks about salinity reduction and energy conservation. Water scarcity combined with population growth and climate change, especially in semi-arid and arid regions like Australia, Western United States, and the Middle East, has increased the need for water conservation. Water reclamation and reuse have become an important source of water to conserve and extend water supplies. With the advancement of technologies, indirect potable water reuse (IPWR) and direct potable water reuse (DPWR) have been developed as methods for producing high-quality recycled water for potable use. In this research salinity removal and energy conservation associated with IPWR and DPWR were modeled using the system dynamics software Stella. The water/wastewater system of the Las Vegas Valley, Nevada, USA, which discharges into the Colorado River, was used as an example system augmented with reverse osmosis (RO) membranes. The results show that IPWR and DPWR reduce salinity discharge to the Colorado River. The TDS load is reduced to 0.85 and 1.02 million kg/day for DPWR and IPWR systems compared to 2.33 million kg/day by the year

2035. DPWR can also save about 50% of the energy cost of pumping water. However, one drawback with these systems is the approximately 5% loss of water in the brine of the membranes.

From the study entitled “Impact of Agricultural Practices on Groundwater Salinity” by D. L Suarez [19], the impact of agricultural practices on water quality has been examined predominantly with an emphasis on surface water. Impacts on groundwater, as compared with surface waters, are much more difficult to quantify. This is due to larger travel times to and in groundwaters as compared with surface waters and difficulty in sampling groundwaters properly. Despite these difficulties in quantification, the impacts on ground- and surface waters are equally important. In non-irrigated areas agriculture often leads to increased recharge, sometimes resulting in the leaching of salts from the unsaturated zone into groundwater. In irrigated areas groundwater salinization can result from irrigation with saline water, salt water intrusion owing to pumping of groundwater, downward movement of salts in the unsaturated zone or dissolution of saline minerals, and from the unavoidable concentration of salts owing to plant water uptake. The interrelationship of surface and groundwaters must involve water quality as well as quantity.

Extensive research has been conducted on the management of agriculturallands in order to minimize the impact of salinity on crop productivity. In contrast, very little research has been focused on the impact of agriculture on groundwater salinity. This is a serious deficiency in that ground- and surface waters are inevitably linked and need to be considered together in the overall management of our resources. This concept, in the form of conjunctive use, has long been recognized for quantitative water utilization, but less so for water quality.

The study entitled “Plantations, river flows and river salinity” written by Robert A. Vertessy , L. Zhang & W. R. Dawes [20] talks about large-scale plantation development will exert additional pressure on a water resource system that is already under considerable stress. Tree planting will reduce river flows and recharge to groundwater and, in certain circumstances, may lead to short-term worsening of river salinity prior to any improvement. Reductions in flow will be particularly problematic during dry spells, when water resources are sorely stretched. Most of the likely hydrologic impacts of afforestation can be predicted using current catchment models, but new field data are needed to test and improve their accuracy. Reductions in river flow induced by afforestation can be minimised with careful planning, and various strategies to minimise impact are recommended. It is argued that a regulatory framework needs to be erected to control the development of new plantations in order to complement other policies to preserve water resources, such as the cap on diversions in the Murray-Darling Basin and recently introduced legislation on farm dams. Given the future need to allocate additional river flows to the environment, new allocations of water to plantations should be offset by up-front transfers of water from other uses. We argue that water use by plantations should be factored into the water economy of catchments.

According to the study with the title of “Irrigation with saline water: benefits and environmental impact” by Julián Martínez Beltrán [21] shortage of water resources of good quality is becoming an important issue in the arid and semi-arid zones. For this reason the availability of water resources of marginal quality such as drainage water, saline groundwater and treated wastewater has become an important consideration. the irrigation return flows with water or poor quality are a source of pollution of the surface water bodies situated downstream of the drainage outlet. Deep percolation could also contaminate the groundwater. Therefore, irrigation with saline water requires a comprehensive analysis even beyond the area where water is applied. Consequently, the sustainable use of saline water in irrigated agriculture requires the control of soil salinity at the field level, a decrease in the amount of drainage water, and the disposal of the irrigation return flows in such a way that minimizes the side effects on the quality of downstream water resources. This paper describes the guidelines for a preliminary evaluation of the suitability of water for irrigation and the key factors for salinity control in lands irrigated with saline water. Options to improve the quality of the drainage water, strategies for the reuse of this water and alternatives for disposal of the outflow are also analysed. The final goal is to obtain sustainable agriculture and maintain the quality of the water resources in the river basin.

A study entitled “The effect of salinity on water productivity of wheat under deficit irrigation above shallow groundwater” by J.W.Gowinga, D.A.Rosea, and H.Ghamarniab [22] which mentions saline groundwater is often found at shallow depth in irrigated areas of arid and semi-arid regions and is associated with problems of soil salinisation and land degradation. The conventional solution is to maintain a deeper water-table through provision of engineered drainage disposal systems, but the sustainability of such systems is disputed. This shallow groundwater should, however, be seen as a valuable resource, which can be utilised via capillary rise (i.e. sub-irrigation). In this way, it is possible to meet part of the crop water requirement, even where the groundwater is saline, thus decreasing the need for irrigation water and simultaneously alleviating the problem of disposing of saline drainage effluent.

Management of conditions within the root zone can be achieved by means of a controlled drainage system.

The study of A. RangaRaoa, C.Dayanandaa, R.Saradaa, T.R.Shamalab , and G.A.Ravishankara entitled “Effect of salinity on growth of green alga Botryococcus braunii and its constituents” the growth of Botryococcus braunii (race ‘A’) and production of its constituents viz, hydrocarbon, carbohydrate, fatty acid, and carotenoids were influenced by different levels of salinity. he increase in biomass yields and changes in other constituents indicated the influence of salinity and the organism’s adaptability to the tested levels of salinity (17 mM to 85 mM).

M. Barletta , A. Barletta-Bergan , U. Saint-Paul , G. Hubold made a research about “The role of salinity in structuring the fish assemblages in a tropical estuary” the present study describes the seasonal changes of the fish species composition in three areas of the main channel of the Caeté River estuary, Brazil. The fish faunas of each habitat differed in density, biomass and species composition n the Caeté estuary seasonal salinity fluctuations appeared to be the main factor that structured the fish assemblage in the entire estuarine system. At least 85% of the species captured by the artisanal and subsistence fisheries in the Bragantine region required estuarine conditions to complete their life cycle.

From the study of Cyrus, D. P. and Blaber, S. J. M. entitled “Turbidity and salinity in a tropical northern Australian estuary and their influence on fish distribution” it talks about the influences of turbidity and salinity on fish distribution in tropical northern Australia. Both turbidity and salinity varied significantly during the year but three clearly distinguishable seasonal patterns existed. These are referred to as the Wet, Early Dry and Late Dry Seasons. Turbidity and Salinity gradients were continuous in the adjacent marine environment of Albatross Bay. The data showed that the densities of the fish within the estuary were related to turbidity and salinity. There is an strong inverse relationship between turbidity and salinity.

From the study “Very low salinity regions of estuaries: important sites for chemical and biological reactions” written by A. W. Morris R. F. C. Mantoura, A. J. Bale, and R. J. M. Howland it talks about THE importance of biogeochemical interactions in estuaries is widely recognised1,2,4–6; in particular, theoretical models of estuarine speciation of trace metals7 and of the pH–carbonate system8 predict that sharp changes of thermodynamic equilibrium conditions should occur at very low salinities (<1‰). However, because of the limitations of conventional sampling strategies12, the chemical properties of this freshwater–seawater interphase (FSI) have not been adequately characterised. Instead, the expected variability has usually been represented by a scatter of spatially and temporally unresolved data points1,3,5,6. Over the past two years, we have carried out periodic detailed investigations of the immediate mixing of the fresh and brackish water in the Tamar Estuary, South West England and we present data here for 11 determinands which point to the FSI as being an important site for chemical and biological processes in estuaries.

Synthesis of the Art

From the article of “Salinity” by Bayville, **salinity** is defined as the amount of **salt** in water. Sudden changes in **salinity** may kill some **organisms** and weaken others making them to be more susceptible to diseases and other environmental stresses. By measuring **salinity**, it allows the researchers/scientists to discover if a specific **organism** will survive in the area where the salinity was measured. To measure the **salinity**, use a **conductivity meter** or by using a **hydrometer**. This article focuses more on the **organisms** which inhabits in an **estuary areas**.

Whereas, the article “All about salinity” from the Office of Environment and Heritage, defined **salinity** as the presence of salt in the land surface, in soil or rocks, or dissolved in water in our **rivers** or **groundwater**. These review focuses more on how to manage the **salinity**. It suggests to change on how we use our land so less water goes into the **water table**, use water more efficiently and effectively. The authors on these reviews defined salinity in same way, the management on the salinity may help on comprehension of organisms react on **saline areas**. This will act as an action point for this term paper.

The study “Salinization: A major threat to water resources in the **arid and semi-arid regions** of the world”, the authors of this study used **salinity**, **arid**, and **semi-arid regions** as a variable. It discussed about the salinity of many large **natural salt lakes** in **drylands** are rising as waters is diverted from their inflows for **irrigation** and other uses. As **salinity** continuously rise, it might affect the living organisms present in **arid** and **semi-arid** regions which may cause a shortage may on supply.

While in the study of “Effects of increasing salinity on **freshwater ecosystems** in Australia” mentions that the organisms that live on these systems sustains itself by the process of **tolerance or avoidance**. It focuses on the structure and functions of **aquatic systems** change due to the increase of **salinity**.

The study “Effects of salinity on river, stream, and wetland ecosystems in Victoria, Australia” used a from previous reviews of authors about the **lethal and non-lethal effects** of salinity to the individual species with groups of **aquatic organisms**. Using these data to determine the possible effects of **saline wastewater discharges** to **estuary areas, lowland rivers, wetlands, and streams.**

These studies discuss about how **salinity** could be a great threat to the **ecosystem**. It measures the amount of salinity present in arid and semi-arid regions. It tackles about the **lethal** and **non-lethal effects** of salinity to **aquatic organisms.**

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