ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

AN ASSESSMENT OF "BASIN CONSERVATION PLAN" AS A TOOL FOR ECOLOGICAL RESILIENCE OF SOCIO-ECOLOGICAL SYSTEMS: CASE OF EĞİRDİR BASIN

M.Sc. THESIS

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Department of Urban and Regional Planning

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(502141823)

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Thesis Advisor: Prof. Dr. Azime TEZER

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ISTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

SOSYO-EKOLOJİK SİSTEMLERİN EKOLOJİK DAYANIKLILIĞINDA BİR ARAÇ OLARAK "HAVZA KORUMA PLANI"NIN İRDELENMESİ: EĞİRDİR HAVZASI ÖRNEĞİ

YÜKSEK LİSANS TEZİ

Eren Çağdaş Bilgiç

(502141823)

Şehir ve Bölge Planlama Anabilim Dalı

Şehir Planlama Programı

Tez Danışmanı: Prof. Dr. Azime TEZER

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Eren Çağdaş BİLGİÇ, a M.Sc. student of İTU Graduate School of Science Engineering and Technology student ID 502141823, successfully defended the thesis/dissertation entitled "AN ASSESSMENT OF 'BASIN CONSERVATION PLAN' AS A TOOL FOR ECOLOGICAL RESILIENCE OF SOCIO-ECOLOGICAL SYSTEMS: CASE OF EĞİRDİR BASIN", which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor :	**Prof. Dr. Azime TEZER** İstanbul Technical University	.....
Jüri Members :	**Prof. Dr. Öner DEMİREL** Kırıkkale University	.....
	Asst. Prof. Başak Demireş ÖZKUL İstanbul Technical University	.....

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To my family and beloved Asmin KAVAS,

FOREWORD

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Eren Çağdaş Bilgiç

(Urban Designer and Landscape Architect)

TABLE OF CONTENTS

Page

ABBREVIATIONS

BCP : Basin Conservation Plan
ELBCP : Eğirdir Lake Basin Conservation Plan
ELSPP : Eğirdir Lake Special Provisions Plan
ER : Ecological Resilience
ES : Ecosystem Service
FAO : Food and Agriculture Organization of the United Nations
NHLD : Northern Highlands Lake District
NOAA : National Oceanic and Atmospheric Administration
PE : Political Ecology
SES : Socio-Ecological Systems
UN : United Nations
UNEP : United Nations Environmental Program
MEA : Millennium Ecosystem Assessment

LIST OF TABLES

Page

LIST OF FIGURES

AN ASSESSMENT OF "BASIN CONSERVATION PLAN" AS A TOOL FOR ECOLOGICAL RESILIENCE CONCEPT CASE OF: EĞİRDİR BASIN, ISPARTA

SUMMARY

Recent studies show that human being's impacts on Earth's systems are increasing (Rockström et al., 2009). According to WWF statistical report on ecological footprint, since 1961, human beings' demand on natural resources has increased by approximately 140%. The earth's bio-productive landscape is insufficient to support competing demands of human beings (WWF et al., 2014) and development such as consumption patterns, urbanization, unqualified living areas, and population increases (Karr, 1999). It is clear that these estimations suggest the requirement of systematic and sustainable assessments of demand on the Earth's limited biosphere.

On the other hand, the functioning of natural landscapes, which are supporting well-being of human needs, are crucial for the sustainability of life on earth. In this context, especially fresh water resources have an important role on social and ecological systems. Besides the drinking water supply, fresh water sources support industrial production processes and the irrigation of agricultural lands (in the social framework). Additionally, fresh water sources keep alive aquatic and terrestrial dynamics such as being habitat for numerous fauna and flora species (Sharip, 2010). Unfortunately, the result of unsustainable usage and pollution of fresh water systems have caused water scarcity on Earth (UNEP, 2006).

All these negative influences on aquatic ecosystems bring out the importance of studies on the components of social and ecological systems. At the end of the 20th century, the "ecological resilience" concept emerged through C. S. Holling in 1973, "ecosystem services" was derived from Walter E. Westman's natural capital studies in 1981, the "political ecology" term was evaluated by Blaikie and Brookfield in 1987, and "intervention ecology" was practically studied by Hobbs in 1996. As a result of increasing importance of conservation, sustainability and management of fresh water systems, this study puts under lenses the conceptual backgrounds and interactions of socio-ecological systems and ecological resilience in water basins.

Consequently, Turkey's second biggest fresh water basin, Eğirdir Lake was chosen as a case study, and Eğirdir Lake Basin Conservation Plan was evaluated within the scope of socio-ecological systems and under the lenses of ecological resilience. As a result, it will be understood that, whether Eğirdir Lake Basin Conservation Plan, an influential instrument to assess the relationship between socio-ecological systems and the ecological resilience.

EKOLOJİK DAYANIKLILIK KAVRAMINDA BİR ARAÇ OLARAK "HAVZA KORUMA PLANI"NIN İRDELENMESİ: EĞİRDİR HAVZASI ÖRNEĞİ

ÖZET

Son zamanlarda birçok bilim insanı tarafından yapılan araştırmalar, insanın biyosferde bulunan doğal sistemler (gıda, su, fauna, flora vb.) üzerindeki etkisinde bir artış olduğunu göstermektedir (Rockström et al., 2009). Dünya'daki çeşitli ülkeler tarafından yürürlüğe giren sayısız çevre politikalarını yetersiz, taahhüt vermeyen, yol haritası çizemeyen, gelişmiş diğer ülkelerden taleplerini net olarak belirtemeyen, sorumluluk almayan ve vizyonsuz olarak nitelendiren 'Doğal Hayatı Koruma Vakfı' (WWF)'nın ekolojik ayak izini konu alan istatistiki raporuna göre, 1961'den bu yana insanoğlunun doğal kaynaklara olan talebi % 140 oranında artmış durumdadır. Dahası bu ivmeli artışın önümüzdeki yıllarda önünün alınamayacağı bir duruma geleceği açıkça görülebilmektedir. 2000 yılından sonra, Dünya'nın biyoüretken peyzajı bu talepleri karşılayamamaya (WWF et al., 2014) ve vahşi tüketim modelleri, kentsel dokular, niteliksiz yaşam alanları ve artan nüfus gibi etkenler de bu talepler için yetersiz kalmaya başlamıştır (Karr, 1999).

Bahsi geçen karbon ayak izlerinin ölçümleri göstermektedir ki, günümüzde gezegenimizde yaşayan tüm insanlar, kullanabilecekleri kapasitenin yarısı kadar fazla miktarda doğayı yok etme eğilimindeler (Öztok, 2013). Bu veriler ve tespitler doğrultusunda belirtilebilir ki, biyosferin ihtiyacı olan sosyo-ekolojik sistem sistematiği ve bu sistematiğin de ihtiyacı olan bileşenler, bu kaotik problemin bilimsel ve rasyonel bir çözümü olarak beraberinde gelmektedir.

Öte yandan, insanın hayatî ihtiyaçlarıyla dolu olan doğal peyzaj ve bu peyzajın 'biyosfer' için kritik olan işlevi, hayat için vazgeçilmez ve koparılamayacak bir parça olarak kabul edilebilir. Bu bağlamda, biyosferin en önemli modülü olarak sayılabilecek tatlı su kaynakları, toplumsal ve çevresel sistemlerde önemli bir rol oynamaktadır.

Biyoçeşitlilik çerçevesinden bakıldığında tatlı su kaynakları, gezegendeki fungi (mantar), fauna (hayvan örtüsü) ve flora (bitki örtüsü) çeşitliliğine –doğal olarak da- yaşam döngüsüne de kaynak oluşturmaktadır (Sharip, 2010). Ancak yukarıda da belirtilen ekolojik ayak izlerinin büyük bir kısmı (sürdürülebilir olmayan kaynak kullanımları ve su kaynaklarındaki kirlenme vb.) ise kısa vadede yerel/bölgesel, uzun vadede küresel çevre sorunlarına (erozyon, kuraklık, kıtlık vb.) sebebiyet vermektedir (UNEP, 2006).

Toplumsal sistemlerin çerçevesinden bakıldığında ise, tatlı su kaynakları, içme suyu sağlamanın yanı sıra, sanayi sürecinin yürütülmesinde, tarımsal amaçlı sulamalarda ve atıkların bertaraf edilmesi konusunda da katkı sağlamaktadır.

Yaşanan tüm bu bileşenler ve buna bağlı problem ve tehditler, bahsi geçen toplumsal ve çevresel sistemler çerçevesinde entegre yöntemler gelişmeye başlamıştır.Bu yöntemlerin en üzerinde durulması gerekeni sosyo-ekolojik sistemlerdir (SES).

‘Sosyo-ekolojik sistemler’in araştırma ve yönelim anlayışı, beşeri coğrafyanın, doğal coğrafyadan ayrılamayacağı ilkesine dayanmaktadır. Disiplinlerarası araştırma temeline uygun, fen bilimleri ve sosyal bilimlerin bağımsız ve farklı yaklaşımının aksine, alışılagelmiş ‘sürdürülebilirlik’ kavramına önemli bir modül olarak giren ve geleneksel bilimden olabildiğince uzak sosyo-ekolojik sistemler, temel ikili sistemin (toplumsal ve çevresel sistemler) barındırdığı tüm bileşenlerin yapısını, sürecini ve birbirleriyle olan ilişkini incelemek üzerine oluşmuştur.

Yıllardır süregelen ve günden güne etkisini artıran ekolojik ayak izleri beraberinde sosyo-ekolojik sistemlerin bileşenleri konusundaki çalışmaların önemini de beraberinde getirmektedir. Bu tez kapsamında incelenecek olan seçilmiş dört bileşen de (1) 20. yüzyılın sonunda, C. S. Holling tarafından ortaya atılan “ekolojik dayanıklılık” kavramı, (2) Westman’ın 1981 yılındaki doğal sermaye çalışmalarından yola çıkarak üretilmiş “ekosistem hizmetleri,” çalışmaları, (3) Blaike ve Brookfield’ın 1987 yılında geliştirdikleri “politik ekoloji” kuramı ve (4) Hobbs tarafından 1996 yılında uygulama alanında geliştirilen “müdahale ekolojisi” konuları altında birleşerek bu bileşenlerden yalnızca bir kaçını oluşturmaktadır.

İlk olarak ‘ekolojik dayanıklıkık’ kavramı, bir canlı ya da ekosistemin dışarıdan gelebilecek bir tehdit unsuru, karışıklık ya da bozulma sonrasında şeklini, yaşam biçimini (beslenme, üreme, vb.) ve konumunu geri kazanabilme yeteneği olarak nitelendirilebilir (Holling, 1973). Somut olarak belirli göstergelerle kolayca incelenemeyen ve bu sebeple de fazlaca çalışılamayan ekolojik dayanıklılık kuramı, literatürdeki kaynak yetersizliklerine de sebep olmuştur. Ancak, Holling’le başlayan ve günümüzde Gunderson, Berkes, Folke gibi araştırmacılarla devam eden ‘ekolojik dayanıklılık’kuramı, sosyo-ekolojik sistemlerin karmaşık ilişkilerine de ışık tutabilen bir bileşen olarak göz önünde bulundurulmalıdır.

‘Ekosistem hizmetleri’ ise ‘ekolojik dayanıklılık’ konusuna kıyasla gerek akademik camiada, gerekse hükümetler arası örgütlerin gündemi dahilinde daha çok üzerinde durulmuş, daha köklü ve daha net çizgilere sahip sınıflandırlamara sahip disiplinlerarası bir çalışma alanıdır. Gretchen Daily tarafından “doğal sistemlerin ve onları oluşturan türlerin insan hayatını sürdürmesi ve yerine getirmesi için gereken koşullar ve süreçler” olarak betimlenen ekosistem hizmetleri, kısaca, ‘ekosistemin insanoğluna karşılıksız olarak vermis olduğu kaynaklar’ olarak tanımlanabilir. 1980’lerde Westman’in doğal sermaye çalışmalarından yola çıkarak türeyen ‘ekosistem hizmetleri’ bileşeni, Birleşmiş Milletler’in 2005 yılında yayımlanan ‘Binyıl Ekosistem Değerlendirmesi’ raporunda da genişçe yer almış ve bu hizmetlerin sınıflandırılması genişletilmiştir.

SES kavramının bir alt tanımı olarak da algılayabileceğimiz, ‘politik ekoloji’ alanı ise, çevre ve onunla karşılıklı ilişkileri olan toplumsal yapıları ve organizasyonları inceler. 80’lerin sonuna doğru ortaya atılan bu yeni kuram, rastlanılmaya pek alışmamış ekonomi-politika-doğa üçlüsünün arasındaki dinamik ve karmaşık ilişkileri sorgulamaktadır (Özberk, 2017). Daha çok sosyal bilimler alanında ele alınabilecek ‘politik ekoloji’, bu çalışmanın kapsamında bahsi geçen sosyo-ekolojik sistemlerin irdelenmesinde bir araç olarak yer alacaktır.

Diğer kuramlardan farklı olarak ‘müdahale ekolojisi’ ise SES’in pratikte irdelenebilecek bir bileşeni olarak kaynaklarda yer almaktadır. Bu pratik, insanoğlunun doğa üzerindeki, yapıcı, onarıcı, yenileyici, ıslah edici ve restore edici her türlü müdahalesini ve bu müdahalelerin doğal süreçteki etkisini, bu etkilerin sürdürülebilirliğini, yönetimini, kullanım-etkilerini ölçüp iyileştirebilen çalışmalar

içermektedir. Bu tez kapsamında, 'müdahale ekolojisi' konusu yukarıda sözü geçen üç teorik SES bileşeninin (ekolojik dayanıklıkık, ekosistem hizmetleri ve politik ekoloji), uygulama alanında bir harcı olarak ele alınacaktır.

"Sosyo-ekolojik sistemlerin ekolojik dayanıklılığında bir araç olarak 'havza koruma planı'nın irdelenmesi: eğirdir havzası örneği" isimli bu çalışma dahilinde, teoride ve pratikte yeni tartışılmaya başlanan, bahsedilen SES bileşenlerinin tatlı su kaynaklarının korunması, sürdürülebilmesi ve yönetilebilmesi konusunda önemiyle ilgili değerlendirmeler yapılması da hedeflenmektedir.

Tüm bu değerlendirmelere ve bileşenlerin interdisipliner önemine bağlı olarak, sosyo-ekolojik sistemlerin bileşenlerinin tanımlanması, ekolojik açıdan dayanıklı sistemlerin irdelenmesi, bu sistemlerin sosyo-ekolojik sistemler dahiline nasıl alınabileceği, ekolojinin politik araçlarının bu çerçevedeki rolü, bu rolün bir amacı olması gereken 'ekosistem servisleri' bu tezin temellerini oluşturacaktır. Dahası, tüm bu bileşenlerin bir harcı olarak, ekolojik müdahalelerin belirlenen ölçümlerini, değerlendirmelerini ve teorik SES dinamikleriyle olan ilişkilerini kurabilmek için seçilen havza koruma planı incelenecek ve tüm bu bileşenler seçilen plan dahilinde irdelenecektir.

Çalışma alanı Türkiye'nin en büyük ikinci tatlı su kaynağı olan, Isparta'da Eğirdir Gölü havzasıdır. Gözlemlere dayanarak söylenebilir ki, bu havza verimliliğinden kaynaklı sanayi, şehirleşme, kültür, tarım ve ormancılık yönünden özgün yapı ve mekan ögeleri içermektedir. Bu yüzden, Eğirdir Gölü Havzası, bu çalışma kapsamında önemli bir SES aracı olarak rol alacaktır.

Yine bu havza dahilinde 2012 yılında uygulanmaya başlanmış, Türkiye'de SES bir araç olarak değerlendirilebilecek en kapsamlı ekolojik müdahalelerden biri sayılan 'Eğirdir Gölü Havza Koruma Planı' (EGHKP), örneklem olarak seçilmiştir. EGHKP, -önceden uygulanmaya çalışılan bölgesel/yerel ekolojik müdahalelerden yanısıra- çeşitliliği, uzun vadeli çalışma planı ve söylemde sosyo-ekolojik sistemlerin bileşenlerine hitap ediş biçimiyle bu tez için önemli bir örneklemdir. Dahası bu plan sosyo-ekolojik sistemlerin arasındaki bağlantıyı, 'ekolojik dayanıklılık,' 'ekosistem hizmetleri,' 'politik ekoloji' ve 'müdahale ekolojisi' bağlamında irdeleyen güçlü bir araç olarak değerlendirilebilir. Görülecektir ki, 'Eğirdir Gölü Havza Koruma Planı' önceden yapılan bölgesel/yerel planların önüne geçmiş olmasına rağmen, gerek paydaşlar arası iletişimsizlik, gerekse yalnızca söylemde kalan politik ekoloji kararları bu planın 'müdahale ekolojisi' alanındaki başarısızlığını ortaya koymaktadır. Dahası, bu plan, 'Eğirdir Gölü havzası'nın 'ekolojik dayanıklılı'ğında olumlu bir etki yaratamamakta (dayanıklı kılamamakta) ve bu anlamda ekosistem hizmetlerinin sürdürülebilirliğini ve etkili yönetimini kapsayabilecek bir politik ekoloji aracı olarak tanımlanmasında bir engel oluşturmaktadır.

1. INTRODUCTION

"The Earth does not belong to man; Man belongs to the Earth. This we know..." – Chief Seattle

The biosphere is increasingly dominated by anthropological activities and if human beings cannot learn how to survive with/in nature, firstly ecosystems, and then the social systems might collapse. For James Karr, development patterns such as urban patterns, unqualified lifestyles, the rapid growth of population, consumption patterns etc. have become dominant against nature (Karr, 1999). When looking back to the ages before industrial revolution, the relationship between human and nature was considered less complicated, because the industrial revolution led to increase natural and man-made resources, energy, land for growing food and living and waste (McLamb, 2011). Starting from this, it can be said that the disintegration between humans and nature has begun with the rise of industrialization and it has reached a peak with high amount of chemicals, land degradation, illegal poaching, deforestation and so on.

Through the late 20th c., the equilibrium of human and nature has started to be identified scientific concepts that represent the link between social and ecological systems. In other words, SES exemplified an integrated perspective of humans in nature and the emerging concept of resilience (Holling, 1973). In this perspective, 'social' refers to human actions e.g. economic, political, technological, cultural etc. and 'ecology' refers to the whole layer of planet Earth, where life exists. Additionally, SES have been elaborated with subsequent studies. These systems have a capacity, which was named as 'resilience' to transform, and adapt in the face of unexpected and external changes. In the scope of this perspective, a SES must be resilient to adapt to human actions that sustain, innovate, and improve development on current pathways (Walker et al., 2004).

It can be observable that, conserving, maintaining, and managing the ecological resilience in socio-ecological systems (SES), human being has started to try several interactions in recent years. Ecological interventions such as restoration, renewal,

regeneration etc. can be counted as the much-discussed and most-implemented interaction to keep the balance between human and nature. So, can these intervention projects help to protect, sustain, and make the resilience of SES better? Can we measure the change? Additionally, if humanity can heal the scars that made on nature, how they can make this change more sustainable and manageable?

At this point, this thesis will compose main concepts, which are related to the ecological resilience (ER) in SES, to analyze practical/theoretical studies on SES, to measure them with previous studies, to compare them with some interventions at basin scale and discuss with a basin conservation plan, which were applied in Eğirdir Basin, Turkey. Through this assessment, it will be understood that, Eğirdir Lake Basin Conservation Plan can be considered as a crucial concrete step, but ineffective intervention for the ER concept and -directly- SES. Accordingly, in the scope of the few numbers of studies on resilience of SES at basin level, this research will be one of the much debated and most illuminative study on the interdisciplinary field of ER concept and practice of SES.

1.1 Problem Statement and Hypothesis

According to population revision of UN (2016), an estimated 54.5% of the world's population is living in urban areas and this ratio is projected as to be approximately 70% in 2050. The ratios for the living beings are also overwhelming. As reported by IUCN Red List, 13.367 animal species, 12.781 plant species, and 49 fungi & protist species are threatened (The IUCN, 2018). Only 12% of land on earth is protected (UN, 2016). It is clear that, the lack of interaction and connection between social systems (politics, economy, etc.) and ecosystems cause crucial threats on the biosphere. For instance, according to UNEP, poaching, conflicts, increasing population pressures, illegal logging, and anthropogenic hazards (war, terror, fire, waste disposal, etc.) are the most hazardous human impacts for changes on ecosystems.

When considered from this point of view, negative influences of human actions on ecosystems will be the major reason of the collapse of the equilibrium between social and ecological systems. Hence, a possible reverse of negative impacts of human beings will help the sustainability and resilience of SES and the productiveness of ecosystem services. Because of that, since the middle of 20th c., for the research realm of ecology

and sociology, ER concept and its effects on SES have been important constituent to examine, measure and manage the positive impacts on SES and possible interventions on ecosystems. Further, if the ER concept in SES can be assessed during or after the practices of ecological interventions, e.g. ecological restoration projects, basin conservation plans, etc., the interdisciplinary framework -as cited above- will be more illuminative and directive to hinder the downfall of the balance of SES.

In this thesis, an ER oriented approach will be examined for the BCP, which will integrate system dynamics, scale, and cross-scaled interactions in SES. This approach suggests that understanding the coupled dynamics of SES allows the assessment of when systems are most vulnerable, restorable and open to transformation. This framework will be examined under the concept of ER for Eğirdir Lake Basin Conservation Plan in Isparta.

1.2 Research Aim and Methodology

'ER' is accepted as one of the most important concept to analyze the bi/unidirectional link between social systems and ecosystems during the last decades (Folke, 2016). It is also important to examine both theories and practices on ER of SES at global, regional, or local level. Briefly, the scale of an ecological intervention in accordance with ER concept will give different meanings and study fields to SES. As expected from this thesis, when the ER and other important components will be evaluated theoretically and with the ecological interventions in different countries, UN, or other global institutions, they will be assessed with an important and comprehensive ecological intervention –named as ELBCP (Eğirdir Lake Basin Conservation Plan),- which is organized by governorship, local bodies of relevant municipalities and political parties. Extensively, the main aim of this study is to examine the resilience of ecosystems, their services, which vary from period to period, and correspondingly, their restoration practices linking with ecological interventions. Meanwhile, the examination of the contexts of SES within ER concept and their practices will be measured with the case of Eğirdir Basin and with the Project of ELBCP, as a tool of ER at basin scale.

In addition, in this study, several sub-objectives will be determined in order to identify the scope and highlights of the research. These sub-objectives form fundamental steps to provide the shape of chapters and to develop the related research process. Within a

systematic design of research flow (Figure 1.1), every objective also directs the analyzing of the research about ER concept, related components of SES, and ecological interventions, which called as practice of ER below, and applicability/feasibility of ecological interventions at different levels.

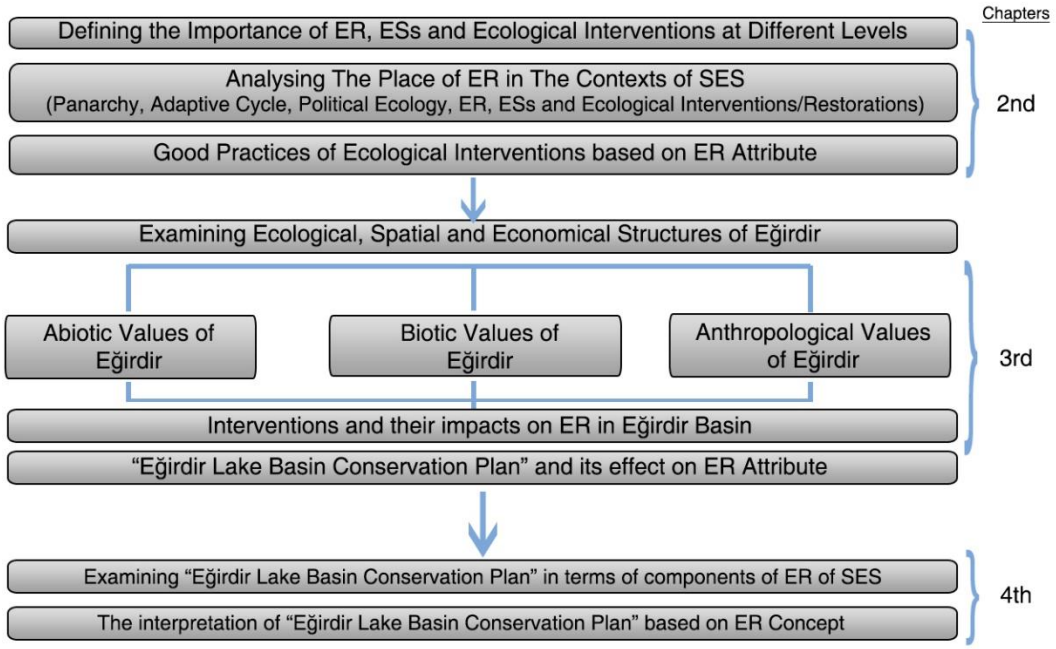


Figure 1.1 : Flow chart of the aim and objectives of the study.

Within the scope of ecological intervention as a tool for ER, ELBCP will be an applicable tool to measure, understand, and discuss the place of ER concept in SES at basin level.

The research begins with defining the components of SES. These systems are chosen according to the studies of Fikret Berkes and Carl Folke. They described the social and ecological systems, which have components of panarchy and adaptive cycle, for ER and sustainability (1998). After their publication, ER concept has been started to study by many earth scientists and sociologists. To strengthen the interdisciplinary link between ecology and social sciences, in the second chapter of this thesis, ER concept will be assessed together with other concepts of 'political ecology' and 'ecosystem services,' which started to rise in the literature after 2000s. In the last aim of the second chapter, another study field on SES, which will be examined as 'ecological intervention.' This practical framework was firstly established in "Towards a Conceptual Framework for Restoration Ecology" by Richard J. Hobbs (1996), who will be assessed with his perspective at this research. At the third chapter, "ELBCP,"

which is superimposed with early interventions for Eğirdir Basin and firstly started in 2012 by the Ministry of Forest and Water Affairs, The Governorship of Isparta, and the Ministry of Environment and Urbanization; and supported by WWF and Siemens home appliances (T.C. Orman ve Su İşleri Bakanlığı, 2013). Moreover, to understand ecological, spatial, and economic structures of Eğirdir, the research will examine the water quality values of Eğirdir Lake, biodiversity and cultural/anthropological values of Eğirdir District. Last, the conclusion part will study how SES dynamics integrate each other in the scope of ER at basin level and, how much is the BCP effective at the restoration of ER. To answer these questions, the research will take an advantage of statistical data and academic studies given from Isparta Suleyman Demirel University, district directorates of ministries, institutions and organizations, and Eğirdir inhabitants, who have a role on ELBCP. Case study of the research was selected as Eğirdir Basin because first, the basin is on an important climatic region (inner Mediterranean climate) and has a rich floral-faunal characteristics and it contains Eğirdir Lake, which is the 2nd largest freshwater of Turkey (Serin et al., 2008). Secondly, Eğirdir Basin with 5 districts and totally 82 settlements together with urban and rural ones (T.C. Orman ve Su İşleri Bakanlığı, 2013), it is a relevant case for reviewing SES.

This thesis contains conceptual assessments and on-site interviews as a composite research methodology (Figure 1.2). As cited below, the research starts with research questions to illuminate the aims of the thesis and combines with the literature review to open up the components of ER in SES. Secondly, case study assessments and data collection, which are nurtured from questions and literature analysis, achieve the conceptual reviews of "ER-" in the case study area. Third, as tools to measure and examine the practice of ER, the opinions of Eğirdir inhabitants through a field study in 2017, together with important official statistics on agricultural data from TÜİK (2017) were collected to evaluate the condition of case study area according to the conceptual assessments of ER in SES.

Yangfan Li's comparative model of change of water quality values (2013) and the alteration of ER states theory of Carpenter et al. (2001) and Post et al. (2002) are benefited within an extensive SWOT Analysis for the BCP. As these pioneering theories are assessed, these analyses will be used for, firstly, developing the interconnection between the social systems and ecosystems in Eğirdir Basin as a tool

to investigate the applicability of ER as a tool for the development of ecological intervention project, and secondly, examine the practicality of better-organized ecological inventions for SES.

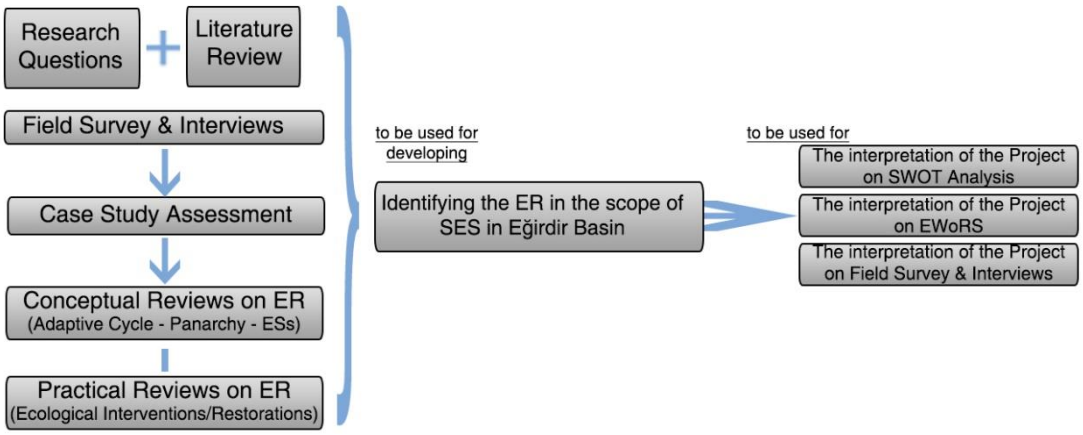


Figure 1.2 : Schematization of the research methodology.

SWOT Analysis

Both social and ecological factors in accordance with ER concept can be grouped into four categories of SWOT Analysis Process. This methodology is generally applied in support of decision making for management and business field (Craig Fleisher, 2002). However, recently it is also used for the assessment of SES and environmental management issues. In 2014, R. Scolozzi et al. applied the SWOT Analysis to the conservation planning from the perspective of ecology and society in their essay, named 'Ecosystem Services-based SWOT Analysis of Protected Areas for Conservation Strategies.' Moreover, in 2016, J. W. Bull et al. published an essay, 'Strengths, Weaknesses, Opportunities and Threats: A SWOT Analysis of the Ecosystem Services Framework.' These two publications have not only most cited articles about SES that examined by SWOT methodology in Web of science, but also develop the decision-making on natural resource management and interpretation of complexities of human-nature interactions (Bull, et al., 2016).

In parallel with this methodology, this thesis will evaluate the strengths, weaknesses, opportunities, and threats for Eğirdir Basin after the impacts of the BCP on ER of Eğirdir Basin's SES. The analysis of these contexts will be benefited from data from on-site interviews, Turkish Statistical Institute, local fishery cooperatives, local NGOs, District Directorate of Food, Agriculture, and Husbandry, District Directorates of

Political Parties, etc. SWOT methodology will improve the assessment of consistency for the link between ELBCP and ER in SES, moreover, be supportive for another two crucial methodology for this thesis, 'early warnings of regime shift' and 'field research.'

Early Warnings of Regime Shifts

The studies show that nature always changes. However, in basins, lakes, oceans, arid lands, forests, and coral reefs, these changes might be interrupted by sudden state changes from one to another in ER. These changes have been practically studied under the title of 'Eearly Warnings of Regime Shifts' by Carpenter, Pace, Folke, Walker and other environmental scientists (Carpenter, et al., 2011). According to Carpenter et al., while in the begining ecological regime shifts can be announced by statistical early warning signals such as return rates from rising variance and preturbation. Also for Carpenter, these signals can be measured with the change of ecosystem services or water quality values.

Predicting regime shifts is difficult, but some statistical indicators can provide early warning signals of a regime shift on an ER state. For instance, in the article 'Zooplankton provide early warnings of a regime shift in a whole lake manipulation' by Pace M. L. et al., increasing varience or autocorrelation was used to provide early warnings of regime shifts by comparing food web changes in two lakes, named, Paul and Peter Lakes (2013).

"Warning signals of a regime shift were evident in the manipulated lake during reorganization of the food web more than a year before the food web transition was complete, corraborating theory for leading indicators of ecological regime shifts." (Carpenter, et al., 2011)

After these studies, Carpenter and others published another article to measure ER regime shifts. With this publication, measuring and assessing regime shifts in ER states became simpler and more understandable. In 'Changes in Ecosystem Resilience Detected in Automated Measures of Ecosystem Metabolism during a Whole-Lake Manipulation,' Carpenter et al. expand the study and applied four materials/methods at their study: (1) Fish communities (population changes of largemouth bass (M. salmoides) and other fish communities in Paul and Peter Lakes for three years); (2) Automated Sensor Data (monitoring the data of DO, pH, Chl-a, and temperature in

Paul and Peter Lakes for three years); (3) Statistical indicators; and (4) QD (Batt, Carpenter, Cole, Pace, & Johnson, 2013). Although, third and the last materials/methods are generally applied with by mathematical models and complicated statistical graphics, the first and second ones were relied on simple data on fish catchment and water quality. If caught bass population and water quality values show an unbalanced annual alteration in comparison with reference lake (non-manipulated Paul Lake), it can be said that the change of state of ER indicates early warnings of regime shifts (Batt, Carpenter, Cole, Pace, & Johnson, 2013).

Accordingly, if caught bass population and water quality values show crucial increments and declines and unbalanced alterations (in Peter Lake) in comparison with reference lake (Paul Lake), it can be mentioned that the change of state of ER indicates early warnings of regime shifts (Batt, Carpenter, Cole, Pace, & Johnson, 2013). On the other hand, according to Carpenter's study, EWoRS can be represented by a simple conceptual diagram outlining the experimental design and hypotheses (Figure 1.3). As stated at the chapter about the theory of ER, all three rows are ball and cup diagrams, where the balls represent the state of the system and the steepness of the cups is related to the stability of the system: A ball nestled in a deep cup is stable.

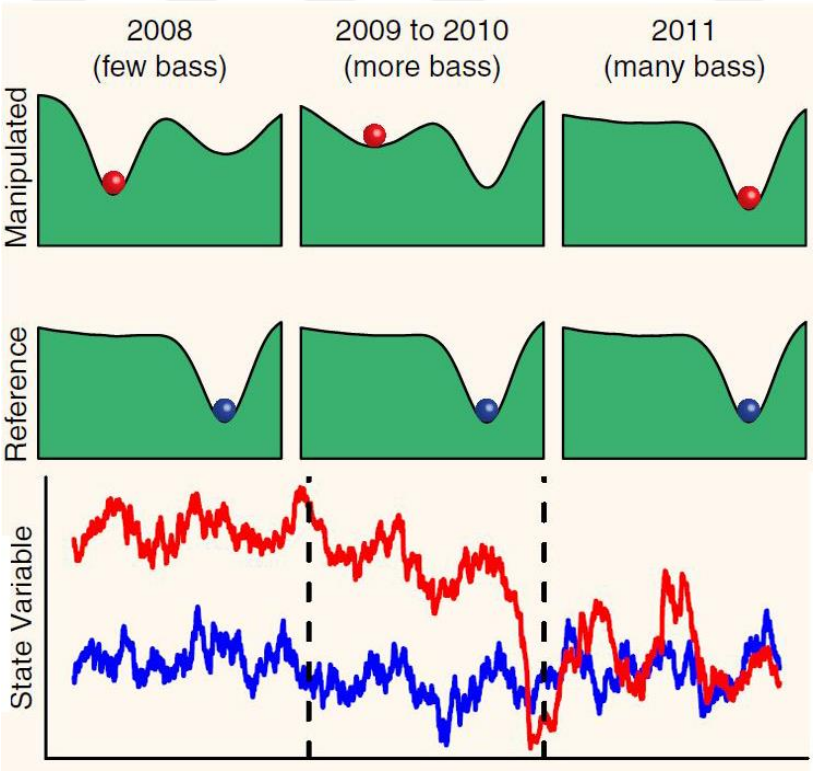


Figure 1.3 : Simple representation of stable ER in terms of EwoRS Methodology by Batt et al (2013).

From 2008 to 2011, the researchers observed the state of ER of lake as stable, moreover, the major parameters, which represent the water quality, phytoplankton biomass, and bass population, indicate that the regime shifts do not give any warning. Otherwise, the red line in the graph indicates the relevant data on Peter Lake, which was determined as manipulated lake in the scope of ER. When Peter and Paul Lake are compared, the researchers found the unbalanced alterations and weakness variances on the state changes in ER.

Within the scope of EWoRS methodology in this thesis, annual statistics of water quality values and caught bass and crawfish will be analyzed, charted and compared with same data from Paul Lake. Hereupon, the implementation date of ELBCP will be marked on the graph and the early warnings of regime shifts will be assessed before and after the BCP. These outputs will contribute to assess the affirmation or negotiation on the achievement of ELBCP's application or management. Nevertheless, as luck would have it, the insufficient water quality and annual caught crayfish data on Eğirdir Lake hinders the five-year measures. According to university libraries, Web of science and other digital databases, the data of water quality assessment can be found only for the year between 1990-2013. However, although this situation obstructs the EWoRS method, field research, two years (2012 and 2013) data after the implementation of BCP, field research on current state of ER in Eğirdir Basin and SWOT analysis, which generated by all findings, will play complementary role in the assessment framework of SES in Eğirdir. To conclude, when the graph as seen in Fig 3.1 will be adapted to the change of ecological threshold in Eğirdir Lake, the variability of the state in ER clearly demonstrates a changeable ball on a stable surface. Accordingly, these changes on water quality parameters, caught crayfish, and phytoplankton biomass will signify the inefficiency of ELBCP in terms of ER in SES.

Field Survey and Interviews

As detailed at second chapter, ER of SES refers to dynamic process of reorganization and adaptive learning in human and ecosystems. Because of that, it can be adventegous that this linkage was examined through formal/informal social institutions and persons in the scope of this research. In 2008, hydrologist Ayron Strauch et al. assessed the dynamics of socio-ecological resilience in East and West Africa with the study of

“Exploring the Dynamics of social-ecological resilience in East and West Africa: Preliminary evidence from Tanzaina and Niger.” The objective of this study is to illustrate the complex ways, which consist of transformation and persistence, two key aspects of the adaptive cycle of resilience, in accordance with the consciousness and awareness of the resilience on ecosystem services in two national parks in Africa (Strauch A.M. et al. 2008).

Accordingly, this methodology, which was inspired from Strauch’s and other ecologists’ studies, will illuminate the complex dynamics of the resilience in SES at basin scale and will be supportive for the assessment of the socio-ecological resilience in Eğirdir Basin.

This method will seek to present pre-findings on the possible indicators of the adaptive capacity of Eğirdir inhabitants and their awareness about the ELBCP, which started to be implemented in 2012.

The interviews within the field study aims to:

- Understand the past situation of ecosystem services, their effects on other dynamics of biodiversity, and their managements in Eğirdir Basin.
- To survey water resource quality using data collection methods.
- To spatially analyze the social and governmental institutions/persons affecting ecosystem services for improving the equilibrium and ER of SES.
- To determine the effects of ELBCP and current situation of SES.

These aims will be reached at the field research to Eğirdir Basin, which was organized at 2017 May. During the research, had an interview and discussion with:

- Ministry of Food, Agriculture and Livestock; Eğirdir Aquacultural Observation Station;
- The Mayorship of Eğirdir Municipality;
- Eğirdir District Directorate of Food, Agriculture and Livestock;
- Süleyman Demirel University, Department of City and Regional Planning;
- Süleyman Demirel University, Department of Agriculture Engineering;
- Süleyman Demirel University, Department of Forestry;

- Süleyman Demirel University, Department of Aquaculture;
- Süleyman Demirel University, Department of Sociology;
- District Presidency of AKP, Eğirdir;
- Directorate of Eğirdir Social Security Institution;
- Eğirdir Cooperative of Fisheries;
- Some Farmers of orchards.

During the research with these representatives/institutions, the general questions below were used to illuminate the research:

- Are you or is your institution be informed about ELBCP?
- Can data about ecosystem services for the lake (crayfish/bass population, freshwater amount used, etc.) be found?
- Can data on water quality of Eğirdir Lake be found?
- Is there lack of communication among institutions, which hinders the implementation and management process of ELBCP and other interventions on Eğirdir Basin?
- Can the positive development be observable on the basin after the implementation of ELBCP and other interventions on Eğirdir Basin?
- Do fisheries benefit from the ELBCP and other interventions on Eğirdir Basin?
- Can a positive development be observable on the quality of aquaculture?
- For what purpose the ELBCP project was implemented? And does it serve the main purpose?
- Is there any noticeable change about the resilience of SES in Eğirdir Basin if you make an assessment of before and after the ELBCP?

1.3 Research Questions

The framework of the research was developed in the scope of main research questions. Every questions certainly have roles to define and analyze the data through linking the ecosystems and social systems within theoretical and practical arguments. First,

analyzing the importance of components of SES (political ecology, ecosystem services and intervention ecology) within the concept of ER plays a crucial role to link social and ecological systems (Berkes et al., 2000). Secondly, these examinations on theoretical framework of SES also enlighten the practical way of the ER concept. At this point, it is a need to ask right questions about the ER concept and related human interventions on the rehabilitation of the resilience, because negative interventions on ecosystem have damaged the biosphere as much as possible (UNEP, 2011). Third, availability, and applicability of Eğirdir Basin -as a case study- must be questioned, because it is important to understand and measure the components of SES at this level. At last but not the least, the most crucial questions must be inquired at the conclusion part of the research. From the start point of the study, theories of SES and the convenience of the case study are discussed to compound theoretical and practical framework of the links between these systems. The main questions and sub-questions, which directly organize the study in chapters of the thesis are:

In the 2nd chapter:

How can ER concept be engaged with other components of SES?

How can ER be measured?

Is ER considered for basin conservation/management plans? If yes, which details does it take?

In the 3rd chapter:

In accordance with ER, what are the general features and structures of the case study area?

What are the ecological interventions to restore the socio-ecological components of Eğirdir Basin so far?

Why 'ELBCP' was selected instead of other interventions?

In the conclusion chapter:

Can 'ELBCP' make the ecology of Eğirdir more resilient?

What can be the indicators of the change of ER in Eğirdir Basin?

How can ELBCP be a tool to examine ER (what is relevant and what is missing in ELBCP?) concept theory and its practice?

1.4 Justification of the Research through Literature Assessment

Ecosystem degradation is growing and spreading unceasingly, accordingly world experiences a human-dominated era (Vitousek et al., 1997). On the other hand, human beings benefit from ecosystem services, which are provided by ecosystems directly or indirectly (MEA, 2005b). In 2015, under the UNFCCC (the United Nations Framework Convention on Climate Change), Paris Agreement, as a major policy issue, identified the loss and damage of ecosystem services, which are caused by slow onset events and extreme weather conditions (UNEP, 2016). It is clear that human beings need to halt their dangerous impacts and fix their hazardous footprints on the environment. Even if it is impossible to restore the entire ecosystems to original states, there can be interventions to recover them as much as possible. Therefore, this thesis will focus on the understanding of the components of ER through integrated ecological interventions in SES with relevant practices from the world and evaluate the relevance of ELBCP according to the identified ER criteria.

Detailed content will consist of chosen three crucial contexts of SES. First and the most important part of the thesis is to identify the components of ER for basin scale interventions. As mentioned below, this concept is a new theory that has been discussed among ecologists, sociologists, urbanists and even engineers since 1980's. Second, the subject of 'ecosystem services' is another inter-disciplinary research realm that constitutes another literature part of this research. ESs and ER Concepts –as imposed for this research- are theoretical part of the literature review and they have been gathered through library databases, subsidiaries, and NGOs of universities and intergovernmental organizations such as UN, World Bank, etc. On the other hand, as practical section of the thesis, ecological intervention is an integral part to substantiate the theoretical section of ESs and ER concepts. To illuminate and correlate these theoretical and practical studies, this thesis will discuss some best practices of ecological intervention projects in the world and Turkey in accordance with the importance of ESs and ER. Correspondingly, chosen samples of interventions will be the most efficient parts to elucidate and enlighten the main challenge of the assessment of Eğirdir Basin's ER of socio-ecological components.

In the line of the main concept, the theoretical framework of ER and related components of SES has been reviewed subsidiaries of universities. These

organizations provide academic leadership about the theory of ER. The examination for the key words, mainly through Stockholm University 'Resilience Centre' and 'Resilience Alliance' provided multidisciplinary research organization's policy contents (2018). On the other hand, the practical methodology of the thesis will be developed through this content to measure, understand, and compare the results of implementations or interventions.

According to the literature reviews about the components of SES' framework, the research has been completed by scientific essays, books, electronical journals, dissertations, conference proceedings and reports.

When analyzed the mentioned contexts of SES in the review of academic publications, as it can be seen at Figure 1.4, the articles from all scientific databases have started to increase after 2005. It shows that the scientific interest to SES has been relatively new subject to research scholars for less than two decades. The reason might be that UN represented the forthcoming environmental danger with Earth Summit in 2002 (NGO Committee on Education, 2002). In the wake of this summit, ecosystem services have been firstly categorized by Millennium Ecosystem Assessment (MEA), which is a major assessment of the environment, in 2005. The description, categorization, and evaluation of ecosystem services have been reviewed in this prominent report (MEA, 2005).

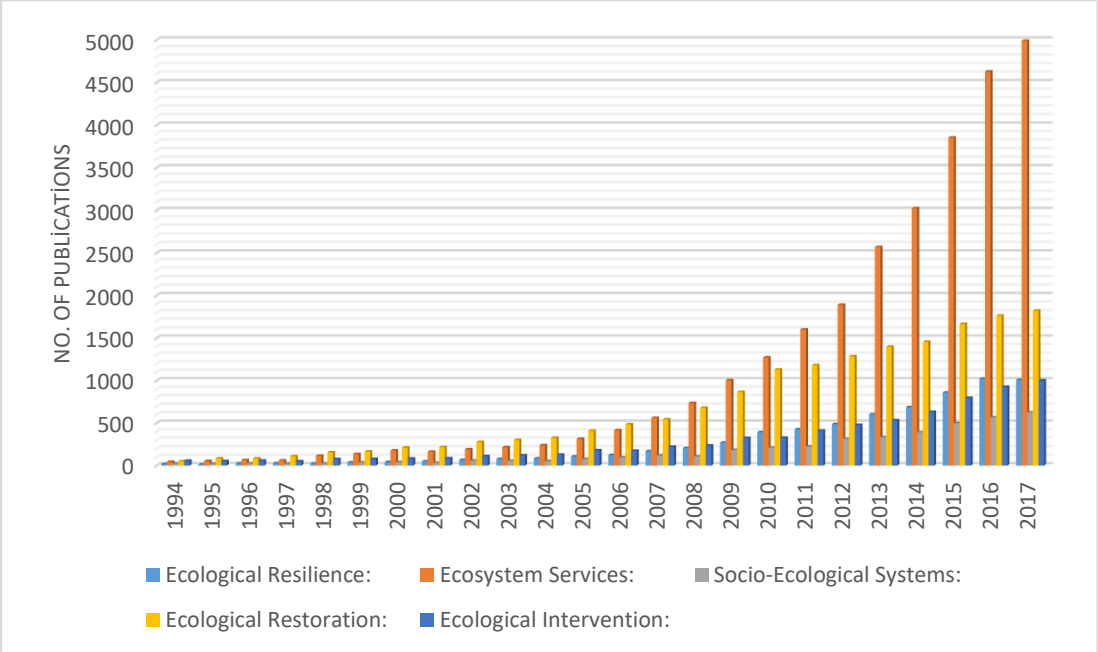


Figure 1.4 : Related key-words in the literature (year by year).

It is also important to categorize the chosen contexts of SES within the literature review to lighten the framework of ER studies at the basin level.

Socio-Ecological Systems

Since 1991, the number of the academic publication academic on SES is 4.516. The main concept of SES was well examined as stated in foremost researchers Fikret Berkes and Carl Folke's 'Linking Social and Ecological Systems' (1998), Peter H. Verburg's 'spatial agent-based models for SES: Challenges and prospects' and Toby Gardner's 'A Social and Ecological Assessment' essay.

Ecological Resilience

Since 1980, 7.364 academic research have been published on the topic of ER. Main researchers on ER concept are Carl Folke, C.S. Holling, B.H. Walker, and Lance Gunderson. Crawford Stanley Holling's 'Resilience and Stability of Ecological Systems' (1973); B. H. Walker's 'is succession a viable concept in African savanna ecosystems?' study (1981); Lance Gunderson's 'Barriers and Bridges to Renewal of Ecosystems and Institutions' article, and -mostly important- Fikret Berkes and Carl Folke's 'Linking Social and Ecological Systems' book (2000) are the examples of significant reference publications on this research realm.

Ecosystem Services

The concept of ecosystem services is another crucial part of the thesis. Since 1980, about 31.016 academic research have been published about ESs. These publications show a regular increase between 1980-2018 years. This alteration shows that the interest to the concept has been increasing day by day. Moreover, Tscharntke (198), Folke (66), Peter H. Verburg (90), Daily (29), and Klein (26) are famous publishers about ESs (Web of Science, 2011).

Ecological Intervention

This will be the third and keystone context of this thesis. 'Restoration' and 'intervention' terms will be used together in the research, because both concepts are generally used in the same meaning. The number of publications, from 1981 to present, about the topic of 'Ecological Intervention' is 7.789. On the other hand, there have been 17.571 publications on the topic of 'Ecological Restoration' since 1981 (Web of Science, 2018). The chapter -themed as ecological restoration- of this thesis has been

proceeded mostly by Halme's, Hobbs', and Ferwerda's studies. The lessons, which are taken to properly restore ecosystem services and ER have been researched from Panu Halme's 'Challenges of ecological restoration: Lessons from forests in northern Europe' project. Later, to understand the essentials and the types of intervention ecology, Richard J. Hobbs' 'Novel ecosystems: theoretical and management aspects of the new ecological world order' journal. In addition, Willem Fermerda's 'Organizing Ecological Restoration' report has been benefited to examine successful practices of intervention ecology types.

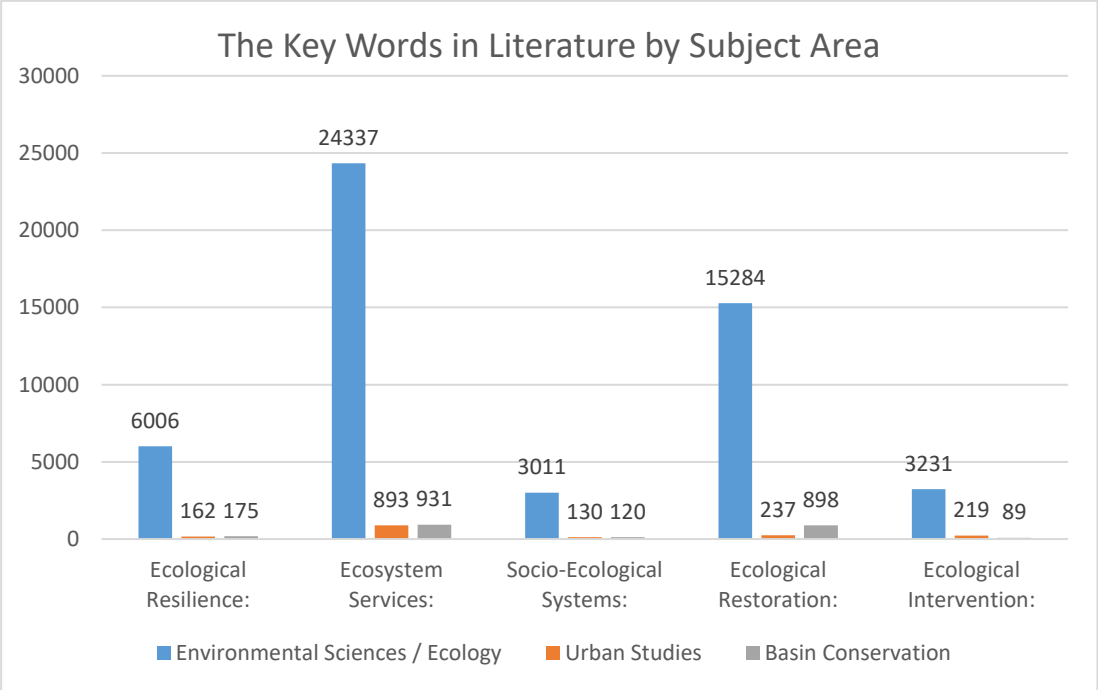


Figure 1.5 : The chosen key words in the literature by subject area.

Although these studies have just been started to examine, they reached a remarkable amount of publications. However, to narrow the research field of this thesis, it will be advantageous to analyze these key words in the literature by related subject areas like 'ecology', 'urban studies,' and 'basin conservation' (Figure 1.5).

When analyzed the SES in literature, although there are 3.011 publications on 'environmental sciences and ecology', there are only 130 publications about 'urban studies' and 120 about 'basin conservation' (Web of Science, 2018). The most cited papers in the field of 'urban studies' is 'Modeling Dynamics of Landscape Structure in Asia's Emerging Desakota Regions: A Case Study in Shenzen,' by DZ Sui and H. Zeng. This article discourse the relationship between SES components by examining

landscape and urban dynamics in accordance with ecological impacts of human activities (2001).

By examining the literature review of 'ER', while 6,006 are related on 'ecology and environmental science,' only 162 are about 'urban studies' and 175 are about 'basin conservation' (Web of Science, 2018). The article 'Resilient Cities: Meaning, models and metaphor for integrating the ecological, socio-economic and planning realms' paper by STA Pickett is mostly cited research with 207 citation (2018).

As mentioned above, 'ecosystem services' has the highest amount of publications at Web of Science. Mostly, these academic research are about environmental sciences and ecology (24.337). Few of the research have been published on the study of 'urban studies' and 'basin conservation.' The number of publication on 'urban studies' is 893 and 'basin conservation' is 931 (Web of Science, 2018). When the most cited paper is examined on urban studies, it can be said that, as a model and scenario, ES concept was analyzed within global change and land-use management issues by Dagmar Schröter in 'Ecosystem Service Supply and Vulnerability to Global Change in Europe' (2005).

As a practical framework, about the key word of ecological restoration/intervention, there are 18,515 on 'environmental study and ecology,' 456 about 'urban studies' and 987 on 'basin conservation.' In the literature on the field of urban studies, 'ecological restoration/intervention' practices are the most cited and mainly discussed on 'environmental justice' and 'planning strategies' key words by outstanding authors, Erik Swyngedouw (2009) and Jennifer R. Wolch (2014).

Briefly, it is clear that there are small amounts of academic research on the inter-disciplinary framework for the context of SES. To compound practical and theoretical perspective of ER concept and its relation with SES components, all these key words must play an important role at interdisciplinary field, because they can be examined as an integration paradigm between spatial or strategic planning with the tools of SES at regional level. These amounts of publications show that there is limited availability to the study of space-related and basin level ecosystem. For instance, noticable theoreticians Berkes and Folke's researches seem unable to go beyond the ecology concept. On the other hand, either the publications of intergovernmental organizations or subsidiary of universities cannot put these concepts into the practice. At this point,

this deficiency within the literature was the most challenging part of the research, because the study topic of this thesis is related on the measurement of ER at basin level, in addition, the chosen keywords of SES require to be inter-disciplinary context.

Insufficient academic dialogue between these practices and theories in literature is not different about the dissertations in Turkey, because the subject of this thesis was not mentioned sufficiently. According to National Thesis Center of Council of Higher Education of Turkey, first, there is not any result on the keyword and its derivatives of 'socio-ecology.' Second, the number of thesis on 'resilience' is 196, but although three of them are about 'urban resilience,' none of them is related on ER. Third, dissertations on 'ecosystem services' were studied mostly. While there are eight thesis on the discipline of landscape architecture and forestry, there is not any study on 'urban/regional planning' discipline. Finally, the number of results about graduate thesis on 'ecological restoration,' there is only one study on the discipline of landscape architecture (2018). Under these circumstances, this thesis will have the importance among the academic studies on urban and regional planning.

1.4.1 Chosen methodology in the literature:

The first chapter and main theme of this thesis relies on firstly theoretical study of socio-ecological contexts and secondly practical study of these contexts (measure and experiments on ER in SES at basin level). Assessment of SES, ER, and ESs in accordance with ecological intervention study was difficult to correlate with the case study of Eğirdir Basin, because there are small amount of interdisciplinary articles about ER concept in SES at basin level as figured as can be seen in Fig 1.5. After all, for some ecologists, like Batt et al., experimental and practical approach on the alteration of ER is exceptional, especially in large-scaled areas such as basins (2013).

According to Stephen Carpenter, some changes on ER contain thresholds and statistical indicators of regime shift on ER can be detected near these thresholds (2011). Therefore, Stephen R. Carpenter and Michael L. Pace examined the capacity of environmental sensors understand trophic cascades by comparing the lakes within and without human intervention to measure and assess the threshold of regime shifts on ER by writing the essay 'Trophic Cascades Revealed in Diverse Ecosystems' (1999).

On the other hand, later Michael Pace et al. compiled these experimental tests and superimposed them with time-series statistical data on water quality values and caught ESs (fish species, crayfish, etc.) by publishing 'Zooplankton provide early warnings of a regime shift in a whole lake manipulation' (2013). He used the result graphs to understand the changing of regime shifts on ER of the lake. Taking into account all of these, to designate the methodology of this thesis have benefited from academic researches and essays about the main themes of 'regime shift,' 'early warning signals of regime shifts' and 'changes on trophic cascades' by Michael L. Pace (1999), Stephen R. Carpenter (2001), and Ryan D. Batt (2013).

1.4.2 Data collection and analysis

During the thesis, there are four types of data, which are academic and political literature, maps, population on biodiversity and water quality assessment, have been examined. In the introduction part of the research, to understand the ER, ESs, and ecological intervention studies, academic literature publications have been used in the 2nd chapter. At the 3rd chapter, the ELBCP and special provision decisions by Governorship of Isparta, Turkish Ministry of Forestry and Water Affairs, Turkish Ministry of Environment and Urbanization will be analyzed. In addition, ecological intervention projects ('Seven Colored Life to Seven Colored Lake') by NGOs and private sectors on the case study basin were examined. At the final chapter, to correlate the academic literature part and practically test the resilience concept on Eğirdir Basin, water quality assessment and population on biodiversity data have been exemplified. The final chapter is the most important part of the thesis, because the measurement methodology of resilience on ESs at the 2nd chapter reflects the experiment about the 'regime shift' and 'threshold' alterations of ER in Eğirdir Basin before and after the BCP.

According to overview of the literature review of this research, the discussion of noticeable theories about ESs and ER combine with leading and successful interventions of ecological restorations. To measure and observe the interventions in accordance with theoretical examinations, 'early warning signals of regime shifts,' 'SWOT Analysis' and 'field research' made an impression on the methodology of the thesis. Under the impacts of these methodologies and strong literature review, the assessment of the contexts of SES in Eğirdir Basin will take form with the data collection, which collected during the fieldwork. Therefore, the huge academic gap

between theory and practice of ER, ESs and ecological intervention in accordance with SES will be filled by measuring regime shift and ES amounts in Eğirdir Basin.

At the assessment chapter of the case study, the database of this thesis has been benefited from face-to-face interviews with Eğirdir inhabitants, Mr. Veli GÖK, who is the district head of AKP (Justice and Development Party), Mr. Ömer ŞENGÖL, who is the mayor of Eğirdir District, district directorate of ministries, departments of urban and regional planning, aquaculture, forestry, agriculture, and sociology of Suleyman Demirel University, which contains rich and current data about Eğirdir Basin, MSc & PhD thesis from the council of higher education, and aquaculture scientists' database about water quality and biodiversity values, which was provided by N. Lerzan Çiçek.

2. COMPONENTS OF SOCIO-ECOLOGICAL SYSTEMS AND ECOLOGICAL RESILIENCE

Biodiversity, which can be defined as the variability and variety of fauna-flora at several levels such as, species, ecosystem, and genetic levels, is crucial to sustain the important functions of ecosystems, its processes and structures (FAO, 2018). Beside biodiversity, the term '*ecosystem*' was first used by plant ecologist Arthur Tansley in 1935. According to him, the ecosystem is in approximate equilibrium and consists of biome and habitat, which are the major parts of whole system of the Earth (Tansley, 1935). It can be said that an ecosystem comprises biotic and abiotic components and they interlinked with each other through energy flows and nutrient cycles. Regarding the equilibrium and disequilibrium among these biotic and abiotic elements, there is no doubt that, human beings have the most effective and dominant role on ecosystems. Anthropogenic disasters, extinctions of species and devastated elements in the nature have been increasing from human interventions (Dublin, 2018). Hence, the relationship between human beings and ecosystems is necessary to research the tools and effects of this linkage and to find reasons and solutions of the problems in these systems.

This relationship between ecological and social systems is firstly named as social-ecological systems by Fikret Berkes and Carl Folke in 1998. Berkes and Folke defined this linkage as an intertwined perspective of nature and human-being relations and related it to an emerging concept of ER (Holling, 1973; Folke 2006). In this concept, the '*socio'* refers to all kind of human interventions, including the political, economic, cultural and technological components, and the term '*ecological'* refers to all living layers of the Earth. As cited above, the biosphere consists of the ecological systems of all integrating fauna-flora patterns, humans, their actions, and relationships with each other and other abiotic factors on this planet. In accordance with this, the diversity of species and genetic resources make the biosphere to adapt to changing conditions and

to be more resilient with high rising scale and speed of socio-ecological impacts (Folke et al., 2016).

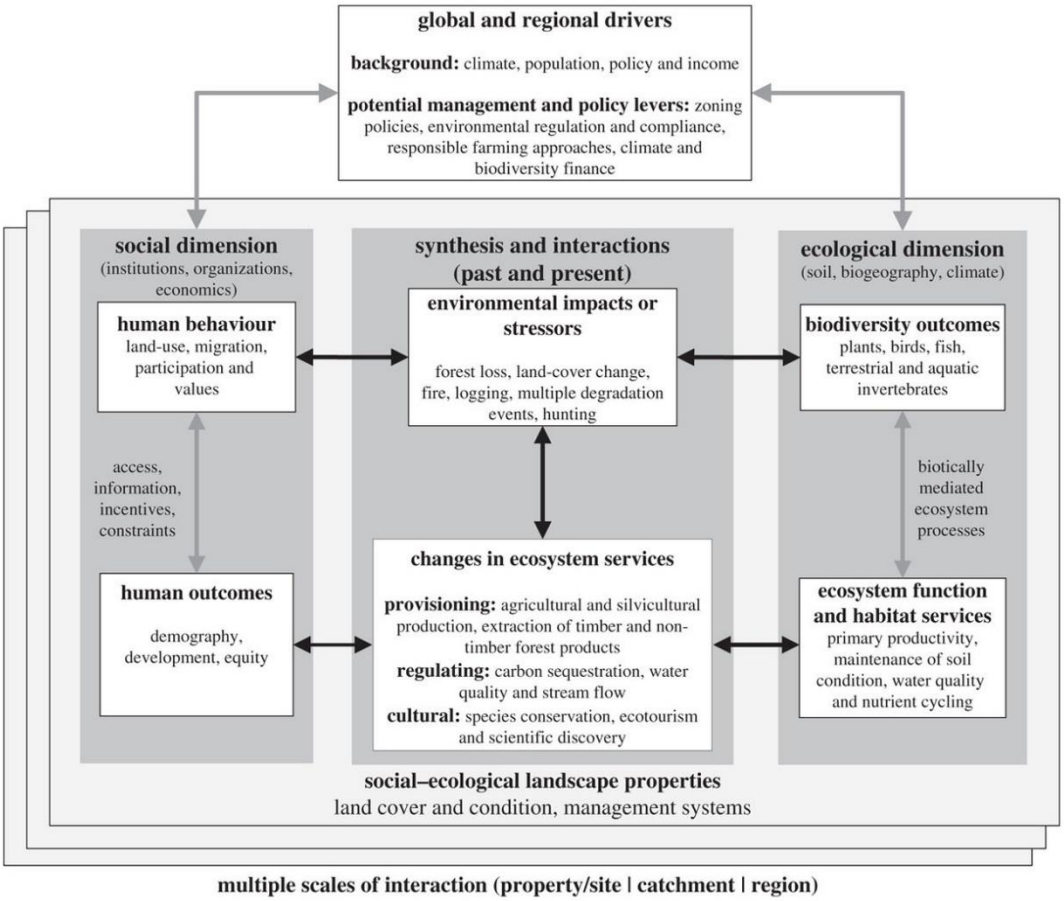


Figure 2.1: Multiple scales of SES' conceptual model (Gender et al., 2013).

In this context, SES can be synthesized with multiple scales (Gardner et al., 2013) (Figure 2.1), defining the system with global and regional drivers. If these systems divided into two dimensions as social -which also named as anthropogenic behavior and outcome- and ecological -which also named as biodiversity outcomes and ecosystem function- the synthesis of these dimensions constituted interactions impacts. Firstly, social dimensions emphasize the anthropogenic systems and their effects on ecosystems. Secondly, ecological dimensions accentuate completely abiotic and biotic elements together with ESs provided by ecosystems. These two integral dimensions are in communication (synthesis and interactions) with each other on a platform, called as socio-ecological system of space. For instance, misusage of land in forest area with diversified plants will cause an environmental impact of forest

fragmentation and degradation; moreover, this will lead a crucial change in ESs provided by this landscape. Throughout these multiple scales of socio-ecological interactions, ER concept, and its practical existence through SES will be visible. As it can be considered as conclusion part, this representation of SES will create an academic framework to assess ELBCP in terms of ER.

Taking into account, the contexts of SES in accordance with ER as mentioned above, it can be constructive that this concept and its relevant practices might be discussible again with the questions of 'how can an ecological system be resilient?' 'How can the threshold of a resilience be measured and observed?' 'Can linear/non-linear dimension between the ecosystem functions, habitat services, and resilience concept be observable?' In addition, 'can ecological interventions recover the ER?'

2.1 ER Concept in SES

To answer the questions above and to understand the components of SES and the essential context of SES, as studied as ER, must be assessed within this perspective. Ecosystems have ability to change its population, form, number of their species, patterns, etc. and have capabilities to respond to a disturbance by recovering themselves and resisting damage (Downing, et al., 2012). Capacity of these capabilities is called as 'Resilience' (Folke, C., et. al. 2002). Canadian ecologist Crawford Stanley Holling introduced the term 'ER' in 1973 to observe the functions and non-linear dynamics in ecosystems. Differently from type of practical terms of ecosystems, Holling's term varies different sets of actions and policies. The term can be described as three parts according to environmental scientist Lance Gunderson (2000). The first part, which also includes examples of field experiments and modelling to understand ecological dynamics, is multiple meanings and concepts of ER as they have appeared in the literature; the second section reviews how ecosystem properties are related to resilience; and the final part includes that can ER be a key to manage complex systems on nature and human?

2.1.1 Resilience in ecosystems and biodiversity

Contrary, ER term was presented to examine dynamic systems' behavior far from the equilibrium. Thus, it can be described as the number and period of disturbances, which

a system can absorb without changing its state. For instance, the size of a fire is related to the state of ER if it can convert a pine forest to a grassland.

The concept of resilience has carried lots of consideration in the literature by Holling (1996), Gunderson (2000), Carpenter (2001), Walker (2004), and Salt (2006) (Table 2.1). There is a need to give an importance to the process of integration between the potential of ER as an instrument for environmental adaptations and its interdisciplinary study.

Table 2.1 : Definitions of "resilience" in the literature.

"A measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables."	Holling (1973)
"The existence of more than one domain of attraction and the maintenance of that global structure through variability."	Walker et al. (1981)
"The magnitude of disturbance that can be absorbed before the system changes its structure by changing the variable processes that control the behavior."	Gunderson and Holling (2002)
"The magnitude of disturbance that can be tolerated before a socioecological system moves to a different region of a state space controlled by a different set of processes, including the degree to which the system is capable of self-organization, and how much it expresses a capacity for learning and adaptation."	Carpenter et al. (2001); Folke et al. (2002)
"The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks."	Walker and Salt (2006)

Alongside complex definitions of ER concept, the ER was represented using an analogy of a ball and topography by Holling (1996) (Figure 2.2). According to Holling's 'a ball on a surface' model:

• The ball would represent the state of the system

• The surface would represent the forces, which act to change the state.

• Pits in this surface would represent stable states.

• Slopes in this surface would represent the strength of the forces, which moves the system in one direction.

ER of a state corresponds to the latitude –can be seen in fig 2.2- of a stability pit. This latitude represents the amount of change that a system would have to experience before it passes the threshold and moves from a pit to another (Liao, 2012).

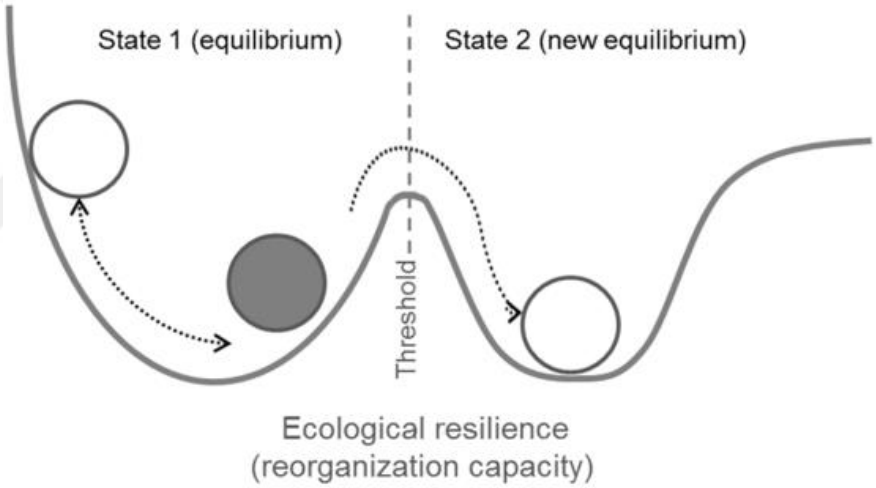


Figure 2.2 : The representation of the ER as a null on a surface (Liao, 2012).

'The ball on a surface model' is a noticeable model to represent the changeable state of ER. From a different framework, ER is the capacity of an ecosystem to absorb disturbance and reorganize with the same structure, function, feedbacks, and identical features during/after a change. According to Walker et al., the term has multiple attributes; however, it is useful to examine four aspects, which are crucial for these definitions (2004):

- *Latitude (L)* is the width of a basin (pit) of attraction. In other words, it is a carried capacity of maximum amount that the system can be changed before losing its ability to recover.

- *Resistance (R)* is depth of basin of attraction's typology. In other words, R is the difficulty of changing the current state of eco-system.
- *Precariousness (Pr)* is basically ecosystem's current trajectory and its current distance to the threshold, which makes recovery impossible, or limit.
- *Panarchy (Pa)* is how L, R, and Pr are influenced by the dynamics and how is it influenced by the sub-systems.

These four terms are also define the measures of ER. Although, none of ecosystems can be described by a stability landscape -especially includes components of SES at different space, scale, organization, and time- stability landscapes can be examined as a metaphor for these measures of resilience, L, R, Pr and Pa.

Stable limit of the systems represent very similar challenges of the management as do thresholds between pits. SESs can be close to crucial thresholds or far away from them (Pr). They can be difficult or easy to change (R). The range of dynamics, which can be accommodated while retaining the same system, can be small, or large (L).

Although it is not clear that their descriptions are separated and they cannot be measured or statistically analyzed, it can be said that each of these components of ER might make nominal and qualitative assessments. In addition, these assessments help to improve how to use the ER concept as a bridge and assist the progress of the process of interdisciplinary SES research.

As cited above, SES have non-linear and complex dimensions during their adaptation process. Practically, these dimensions must be observed by measuring the ER concept in SES. When the ER concept has been investigated with SESs after 2000s, important instruments have been studied to understand and measure the usage of ER. For instance, Yangfan Li et al. research's spatial indicators in processes and patterns can be valid instruments to understand the effects on SES resilience. He analysed Rossi Pierfrancesca's research (2008) about indicators of ecological value and ecological sensitivity and adjusted it to China's Taihu Lake Basin by developing and updating new instruments (2013). These instruments included crucial resilience indicators, which are firstly water quality (worse water quality indicates low resilience), second ecological sensitivity (high sensitivity indicates high resilience), and third vegetation cover (high vegetation cover indicates high resilience) (Li et al., 2013). To conclude, ER concept and its practical effects on SESs might be measured and observed by

ecological quality indicators, which are spatial analysis of vegetation and water quality data. These indicators can rely on mathematical models, remote sensing data management through GIS and statistical changes of outputs.

Clearly, taking the ER concept from ecological and environmental sciences and applying it to social systems with the measures as cited above indicates that there are no important behavioral and structural differences between ecological systems and social structures. However, on the other hand, the parallels between ER resilience and social resilience have been indicated at in different disciplines, including human ecology, social ecology, human geography, and ecological economics (Zimmerer, 1994; Gunderson et al., 1997; Levin et al., 1998). Correspondingly, practical process (ecosystem services, ecological intervention, etc.) of the resilience concept must be discussed at interdisciplinary level. Therefore, political ecology (PE), the study of the link between economic, social, and political factors with environment, will be considered as second component of this level, because the state of resilience can vary from political actions to ecological interventions as a tool for political actions.

2.1.2 The position of ER in the evolution of political ecology

PE should be considered as another significant component of SES at global, regional, and local level. When considered the ER concept is one of the centerpieces for linking SES (Berkes et al., 1998), the term *political ecology* also must be. According to Peet and Watts, the academic discipline of "*political ecology"* studies the integration of socio-ecological sciences with political economy (1996). Robbins claims that the term investigates the topics of environmental conflict, conservation and control, environmental identities, social movements, degradation and marginalization of ecology (Robbins, 2004).

Political ecology term was firstly used as a framework to understand the complex relationship between ecosystems, political and national economies, and relations with local people (Blaikie and Brookfield, 1987). In the discipline of geography, PE has become established as a dominant field of human environmental research. Largely, it has eclipsed its predecessor and cognate field of cultural ecology (Walker, 2005). When C.S. Holling has examined the non-linear relationship between ecosystems and social systems as the name of ER, political ecology term concerns about the political and economic methodology of this relationship. Accordingly, ER concept can be examined as part in the evolution of the political ecology.

While this politics of ecological studies have been improved by many sociologists, ecologists, or philosophers, it can be beneficial that these study fields also can be divided into three terms:

'Social ecology' was firstly used by American anarchist philosopher Murray Bookchin. It claims that the environmental crisis is a result of the hierarchial organization of power and the autoritarian mentality rooted in the structures of our society. The Western ideology of dominating the natural world arises from these social relationships (Bookchin, 1982).

Human ecology is a branch of sociology dealing especially with the spatial and temporal relationships between humans and their economic, social, and political organization (Richard, 1907).

'Political ecology' is one of the main theme of the components of SES in the scope of this research and the study of the relationship between political, economic, and social factors with environmental issues and changes. It also differs from apolitical ecological studies by politicizing environmental issues and phenomes (Robbins, 2004).

About the context of political ecology, William Neil Adger, who is one of the important researchers of human geography, cited the global trends in mangrove conversion in Vietnam. Results from the study, the ecosystem changes in agricultural lands or aquaculture areas in regional scale in the north of Vietnam displays that settling anthropogenic decisions upon the ecosystem services such as privatization of lands or conservation decisions on ESAs, affect the local livelihood systems, local resource use and the equilibrium of the ecosystem (Adger et al., 2000). In addition, it can be discussed that in region scale, some management decisions, which are related with political economy and local resource use, emphasize on the link between local social and ecological systems. In relation to that, political of ecology affects the resilience of the livelihood system dependent on ecosystem services (Adger et al., 2000). This can be reviewable in accordance with examination of the dynamics of income sources, inequality of income sources and property rights at the basin level in the scope of the outputs of Adger's studies.

Political and economic analysis of such a SES might display the link between social and ER by examining the impacts on two groups: extractive users and aquaculture settlers on basin level. As discussed above, the methodology to measure ER and

political ecology factors can depend on ESs generated by aquaculture populations (crayfish or other fish species). The present price of services on the local market, the amount of licensed/non-licensed fishers in cooperative, average income of settlers and economic outputs of the services. According to Folke and Kautsky, when one of the living ESs begins to lose its biological necessary conditions such as health, population or growth rate, the state of the social resilience –at regional level- will naturally reduce (Folke et al., 1992). The possibility of this judgement depends on Folke and Kautsky's study about aquaculture from Central America to the Philippines, Scandinavia, and Vietnam Mangroves. Under the light of these examinations, they have highlighted the negative social and ecological impacts of aquaculture and marine culture (Folke et al., 1992).

The relationship between ecological and social resilience in the evolution of political ecology can be statistically demonstrated. As a subject, social institutions are external pressures, which associated with economic and political change. The ability of the social and ecological resilience in the political ecology state can absorb these changes depends not only on social capital but also on the role of the characteristics of the resource system. In the example of the privatization of the Vietnam mangroves, the returns to aquaculture are much greater than the alternatives of extraction of resources from the mangroves, mainly for subsistence.

Consequently, the interplay of the management of the ecosystem services with the social system forms a direct link between social and ecological resilience. In Folke's and Kautsky's case, one of the external social driver is land reclamation policy. It directly results in ecosystem change, which feeds back to the productivity of the economic activity and the institutional structures managing them.

As an example to illuminate the complex but direct relationship between ecological systems and social systems was addressed on mangrove trees in tropics. Mangrove trees in Campeche, Mexico are using for other uses, generally at the local users' expenses. Mangrove forests definitely provide several positive inputs for fisheries and the protection of coastal biodiversity (Barbier et. al., 1998). Unfortunately, there are several reasons of mangrove loss. For instance, degradation due to pollution, human settlements, and conversion for human settlement and agriculture. Hence, the ER of Campeche's coastal ecosystem and the social system of local communities are related

to institutions of management, environmental policy makers, and property rights issues.

In developing countries such as Mexico, Turkey, Argentine, etc., traditional management of ESs is generally interfered by some authorities by privatization and government policies. However, there are usually rules and property rights, which evolve to meet local resource user needs in spite of these political rapid changes. In conclude, if basins, which provide ecosystem services to local people, and social institutions, which are linked to ecosystem services, are resilient, so it can be possible to observe the impact of 'disturbance' on them results of a similar state or leads to a completely new situation. These new assessments on the theoretical study of PE, moreover, their inputs and outputs affecting the SES were approached with a conceptual diagram –named as adaptive cycle- At this point, it can be advantageous that this detailed and comprehensive representation of PE can be assessed through the ER of SES.

2.1.3 Panarchy and the adaptive cycle of ER

As stated above, when the theoretical framework of ER in SES examined, it can be seen that PE has time-dependent process. In accordance with this process, Panarchy and adaptive cycle of the ER must be represented in the scope of SES in Eğirdir Basin and ELBCP as a tool of PE in Turkey. When the term panarchy is the study of how human development and economic growth depend on ecosystems and social systems, and how they are interlinked with each other, adaptive cycle can be generally represented as a model of systematic change, which proposes that the important parts of ecosystems' cycle have four stages (Figure 2.3):

1. Growth
2. Conservation
3. Release
4. Re-organization

The panarchy and adaptive cycle concepts are mentioned to be tools for ER concept. They focus on processes of reorganization that are generally neglected in favor conservation and growth. In the context of these processes, it can provide a more complete view of ecosystem dynamics, which interact together with ER, its organization and dynamics (Gunderson and Howling, 2002).

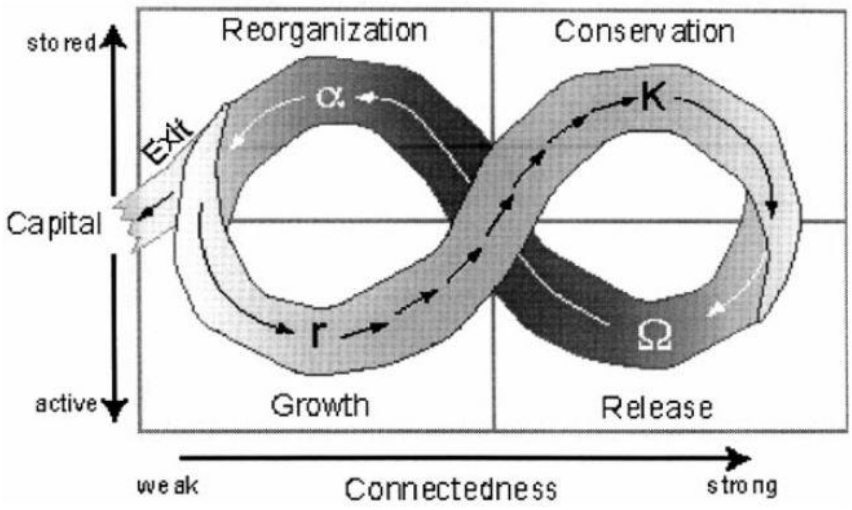


Figure 2.3 : Adaptive cycle representation (Gunderson and Howling, 2002).

The panarchy and adaptive cycle concepts are mentioned to be tools for ER concept. They focus on processes of reorganization that are generally neglected in favor conservation and growth. In the context of these processes, it can provide a more complete view of ecosystem dynamics, which interact together with ER, its organization and dynamics (Gunderson and Howling, 2002).

Threshold of the ER decreases with the movement of cycle from r to K, where the system becomes deteriorating. Until the system passes into a quiet resilient state, this state will quickly change the configuration of the ecosystem, and leave the system open for outputs. Moreover, during this phase, the system can be considered as little resilient and easily reorganized by small inputs.

In the scope of this thesis, the assessment of the components is evaluated so far, it is clear that ER concept actually has an integral role in the socio-ecological systems. Moreover, the regime shifts on a state of an ecosystem –in the short term- affect the landscape patterns related to social systems. For instance, as can be seen at the assessment of ELBCP, the state changes of the vegetation type at meadowlands directly influence the pasturage at the regional level. Accordingly, the husbandry and its outputs at the model of adaptive cycle affect the social systems -especially regional/rural economy. At this point, it can be said that the tangible representation of SES, also known as ecosystem services, is another concrete component of these systems.

2.2 Ecosystem Services in the Concept of ER

Individuals and communities in a livelihood, stability, and social order depend on resource dependency and availability in accordance with their localized economy and resource production (Machlis et al., 1990). Income stability, social stability, and migration are important results of resource dependency and socio-ecological resilience factors. Moreover, this dependency of communities and individuals, which are inside of a resource system, does not only depend on reliance on a fish stock or single crop, but also they depend on an integrated SES.

As an example of the links between ecosystem and social resilience, the demand for diverse and resilient resources relatively determines location for settlement. Differential concentrations of population across a landscape reflect the differing levels of comparative advantage in economic, political, and social parameters of each site.

There is a need to assess the consequences of ecosystem changes for people and to establish the scientific foundations for actions, which are needed to conserve and sustain ecosystems and their donations to people. The term 'Ecosystem Services' was firstly used by Ehrlich et al. in 1981 based on Westman's term of "Natural Services." Accordingly, as grouping at İlke Albayrak's thesis, there are four descriptions for ES:

1. Benefits supplied to human societies by natural ecosystem (Daily, 1997).
2. Direct or undirect benefits of ecosystem functions for human beings (Costanza et. al., 1997).
3. Benefits to human well-being from ecosystems (MEA, 2005).
4. Consumed and benefited ecological products for human welfare (Boyd and Banzhaf, 2007).

For innovative, detailed, and functional research, the description of the Millennium Ecosystem Assessment is preferred. The MEA, which is a major assessment of the human effects on ecosystems, launched in 2001 and published in 2005 by UN. It responds governmental requests to receive information from four important international conventions: 'the Convention on Migratory Species', 'the Ramsar Convention on Wetlands', 'the UN Concention to Combat Desertification', and 'the Convention on Biological Diversity' and to meet the needs of indigenous peoples, non-governmental organizations, the health sector, and the business community. According

to the MEA's 2005 synthesis report, ecosystems, such as marine systems, patterns of natural landscapes, or natural forests, are mostly modified and managed by anthropogenic interventions, such as constructing urban areas and unrestrained agricultural lands (MEA, 2005).

These services are organized into four broad categories: *Supporting services*, such as biodiversity, soil formation, or photosynthesis; *provisioning services*, such as clean water, food, or wood; *cultural services*, such as aesthetic, spiritual benefits, or recreation; and *regulating services*, such as disease, wastes, or floods (Figure 2.4).

Figure 2.4 : Ecosystem services diagram according to MEA (2005).

MEA has determined ESs with their sub-categories according to trends in human use and enhancement or degradation of the ES in the year 2005. It is appropriate that the examination of the ESs and their changes over past 50 years (Appendix C) can illuminate this research by comparing the relationship between social and ecosystems.

It can be said that, although many gratifying or terrifying theories about the future of Earth were presented, every person on the earth needs fully ESs, presently. Over few decades, these ecosystems are extensively and rapidly changed than in any period of anthropologic history. This human intervention, has transformed the planet, has contributed to substantial gains in economic development and human being. However, while some groups of people and regions cannot be benefited from these processes, many have been harmed unfortunately. The MEA determines three crucial problems, which affect negatively some people –especially poor and diminished by the long-term benefits from the eco-system- about our management of the ecosystem services.

These problems are:

1. 15 out of 24 (approximately 60%) ESs are used unsustainably and being degraded, including water and air purification, regulation of local or regional climate, natural hazards, capture fisheries at global scale (MEA, 2005). Of course, the costs of degradation and loss of these ecosystem services are nearly impossible to measure, but scientific data and evidences indicate that they are growing incontrovertible way. Hence, lots of ESs has been damaged because of increase the supply of other services, especially food.
2. According to incomplete but established evidences, some changes, such as abrupt alteration in clean water; disease emergence; climatic changes in regions; the degradation of fisheries; and the creation of 'dead zones' in marine coasts, in ecosystems have been increasing possibility of non-linear changes in ecosystems that have important results for people.
3. The negative effects of ESs (decreasing the capacity of eco-system to deliver services), which are disproportionately carried by the poor, contributes to grow disparities and inequities among different groups of people and caries the principal factor, which causes social conflict and poverty. This is not an indication of that ecosystem changes help to lift many people out of hunger or poverty, but these changes can harm people and their plights that is largely overlooked. Accordingly, in all regions –particularly in sub-Saharan Africa- the management and condition of ESs is a crucial factor, which affects prospects of reducing poverty.
4. According to UN statistics, over the past 50 years, humans have been changing ecosystems more extensively and rapidly than before. These changes made ecosystems more contributed to gains in social systems, but also these gains are

achieving at growing costs in accordance with the degradation of many ESs. These problems will clearly diminish the benefits, which are obtained from ecosystems by future generations. Moreover, ESs' degradation would grow worse during the first half of this century and be an obstruction against the achievement of the Millennium Development Goals of UN (MEA, 2005).

From conserving the environment and protecting bio-diversity to the management claim of ecosystem and its services for human-being, SES and its relationship are taken on a new meaning by the MA's contribution to current ER perspective. In this regard, human supplies from ecosystem services can be critical for ER –in short term- and social systems –in long term-, because the capacity of biosphere serves as human's foundation and social systems that link with this foundation devastate the latitude of ER basins. However, it is clear that the MA has an important role to mainstream, protect, and recover the SES and their resilience.

As another case to examine an intertwined SES, James M. Acheson from University of Maine has investigated the lobster fisheries in Gulf of Maine (2013). Crayfish (Astacidea sp.), which is a lobster species in fresh-water, is an important ES from Eğirdir Lake. Therefore, the lobster industry in Maine can be considered as a remarkable example for ES and ER concepts and be answer for how to measure them and illuminating example of multilevel governance and successful collective action in practice. On the contrary, of other fishing activities in Maine Gulf -both Canada and USA-, the economic value and abundance of this ES has increased and the population of lobster has not collapsed or overexploited. The fishers within a cooperative union in Maine are working to conserve home range of lobsters by minimizing illegal actions and educating other members of the cooperative (Acheson 2003). As statistically cited at fourth chapter, the crayfish activity in Eğirdir Lake also has an important economic value for the Eğirdir Basin, but during 1950s, the fishers, who want to revive the variety of ecosystem services in Eğirdir Lake, release an invasive species –named *zander* (sander lucioperca)-. This species had turned upside-down the biodiversity of Eğirdir Lake and accordingly the SES in the basin.

To conclude, ES can be considered as the most important component of the SES in accordance with ER. If it can be organized, managed, and sustained throughout the equilibrium between social and ecological systems, the resilience of both social and

ecological systems will remain stable and healthy. Because of this, ecological intervention framework is needed to be highlighted while assessing the ELBCP.

2.3 The Position of Ecological Interventions in Terms of the Concept of ER

As mentioned above, the devastation impacts on ecosystems cause the tension of ER thresholds. Even if it is late, human beings have started some action to retrieve the nature that they belong. Either political or spatial interventions on ecosystem can be valuable as revival of ER.

As an important practical instrument for ER, ecological restoration is defined as "the process of assisting the recovery of an eco-system that has been degraded, damaged, or destroyed" by the SES (Society for Ecological Restoration, 2004). According to EU Biodiversity Strategy, ecological intervention can be utilized as practices to end the degradation of biodiversity loss together with, ESs, and restoring them by increasing the ER of ecosystems (2011). To make it more detailed explanation, the central idea of this practice firstly implies to return the eco-system's resilience to some previous state, and secondly appropriately manage this return. In 2009, Richard J. Hobbs, who is one of the important researchers of the practice, used the term 'ecological restoration' to refer to actions aimed at the recovery of ecosystems, rather than broadening the definition (2009), and after in 2011, he claimed that it should be evaluated as a key element in nature for conservation and resource management (2011). Thus, the blooming rate of ecosystem degradation has brought the need for ecological restoration implementations, to achieve its original state as much as possible (Figure 2.5). Accordingly, it can be said that, the term ecological intervention is the science behind the practice of ER building.

In the context of the practice to proof the ER, the long-term aim of ecological intervention should be (1) maintaining biodiversity together with the adaptive capacity and resilience of ecosystems, (2) protecting the natural complexity of the whole landscape and (3) to help the ecosystems to resist degradation in the next (Jackson and Hobbs, 2009). It is clear that single intervention measures generally have more local and short-term objectives, but these actions might be taken acknowledging the long-term landscape level targets.

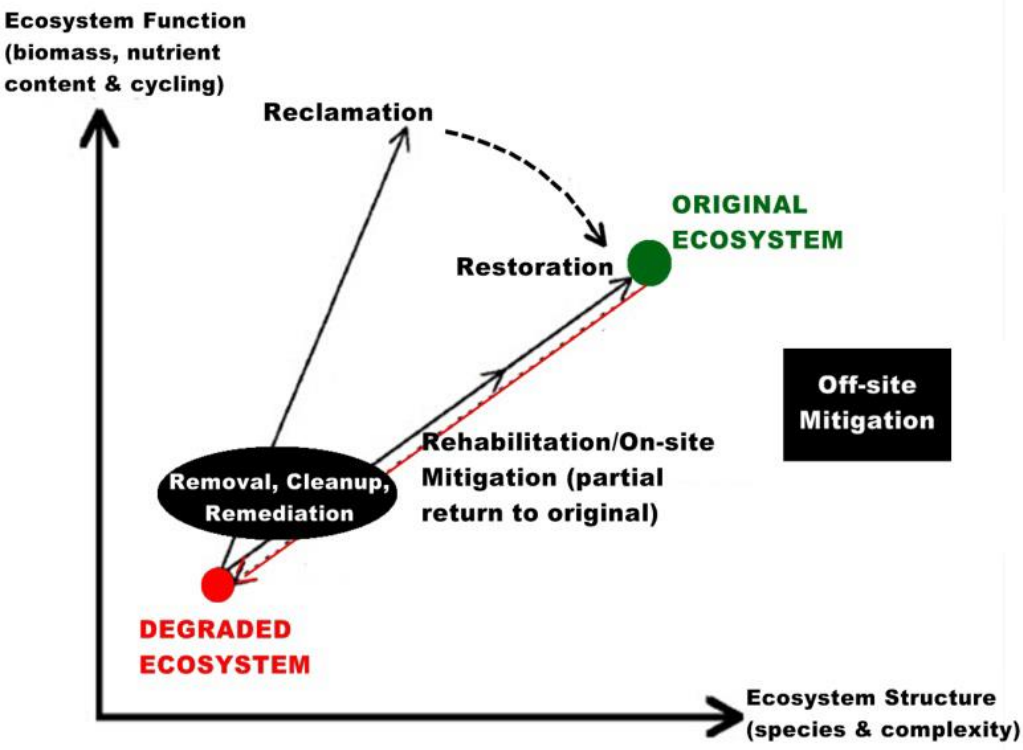


Figure 2.5 : Graphic display for restoration efforts to achieve the resilience state of ecosystems (U.S. Department of interior, 2011).

For instance, like Turkey, Northern European forests may appear as one of the least vulnerable ecosystems from a global perspective, since forest cover is not rapidly decreasing and many ecosystem services remain at high level (Halme et al., 2013). However, extensive areas of European northern forests have been mostly exploited and have lost a major part of their biodiversity value. There is a strong requirement to restore these areas towards a more natural condition in order to meet the targets of the Convention on Biological Diversity (Halme, et. al., 2013). Several countries in EU, Australia, and USA now started to restore forest biodiversity for this challenge. The biodiversity and ecology of forests are relatively well understood making them a good model for restoration activities in many other forest ecosystems.

It is important to understand which functions and structures of the natural ecosystems, which are beyond our capacity to restore for social, economic, climatic, or ecological reasons and which are feasible to restore (Hobbs et al., 2006). As some are easier to restore than others are, the ecological intervention projects must be realistic about what can it be done and what cannot. For instance, according to Niklasson et al., even if it is expensive, at a forest stand level it is straightforward, to use restricted burning to

restore post fire structures (burned living and dead trees) and processes (succession), but it may be unfeasible to restore the natural variability of fire regime at the landscape scale (2000).

While the purpose of ecological intervention is to reintroduce dynamic habitats, single species are often specialized to a particular stage of forest succession or wood decay. Restoration actions should be planned in a way, which maintains ecosystem continuity in space and in time. According to Halme et al. (2013), these actions should be organized with five objectives:

Acquire better ecological knowledge of the target ecosystem

Recent advances have driven a need for novel approaches to forest restoration and ecologically sustainable management in ecological theory and better understanding of the dynamics of unmanaged forest ecosystems (Bergeron et al., 2002; Kuuluvainen, 2002, 2009; Puettmann et al., 2009; Kneeshaw et al., 2011). In particular, since the 1970s, there has been a growing recognition of the importance and ubiquity of natural disturbance in forest ecosystems, first in tropical and temperate forests and later in boreal forests (Pickett and White, 1985; Clark, 1989; Attiwill, 1994; Kuuluvainen, 1994; Kneeshaw et al., 2011).

Be aware of the problems in defining naturalness

While it is crucial to have proper ecological knowledge of the ecosystems we wish to restore, we should be aware of problems related to naturalness, as well as reference and target ecosystems. The aim of restoration is often to add components (species, structures, or dynamics) that are considered natural to the target ecosystem. However, the range of reference conditions used is usually derived from analyses of historical forests that may themselves have been altered by past human influence because humans have been altering forests and their disturbance regimes for thousands of years. Therefore we can hardly know the precise structure of natural ecosystems or even the structure of the past (reference) ecosystems, nor can we predict with accuracy the dynamics of an ecosystem at a particular site following restoration actions.

Assess whether restoration is needed and can be successful with feasible resources

To assess whether, when and where to act, is a difficult task. To successfully predict the success and feasibility of the intervention action, one should consider the present

state of the ecosystem (Wilson et al., 2011), the quality of the surrounding landscape (Kouki et al., 2012), and the potential of the ecosystem to recover (or degrade even further) without intervention. The last point is important because examples of rapid recovery of forest biodiversity without human intervention are globally numerous (Jones and Schmitz, 2009; Holl and Aide, 2011).

Set proper targets and monitor progress

Setting a target for ecological restoration action is essential for verifying the success of the action. Contemporary 'near natural' references may no longer resemble pristine ecosystems, partly because they have naturally evolved, and partly because all forests have experienced some form of human influence (Frelich et al., 2005). However, to assess whether the restored ecosystems are recovering, we should look for reference areas that are as natural as possible, and include these areas in the monitoring schemes. Monitoring reference sites is of particular importance because they are not static but subject to natural dynamics, and because they may alter in response to global climate change. Thus, ecological intervention is likely to have a moving target.

If you still have it – do not destroy it

At last, it is clear that conserving ecosystem services and existing diversity is more economical than restoring those (Halme et al., 2013).

In accordance with these objectives, ecological interventions to restore the resilience must be well understood, because they have become a crucial practice to mitigate climate change, counteract degradations in ecosystems, and develop/maintain ER states by improving biodiversity and ecosystem services.

On the other hand, according to ecologist Richard J. Hobbs, ecological restoration can be motivated by a numerous factors, including a need for increased areas for fodder or fuel, or for the provision of other ecosystem services, such as clean water or climate change mitigation; for biodiversity conservation; or simply for counteracting land degradation (Hobbs et al., 1996). Therefore, intervention practices have types to develop or maintain the resilience of ecosystem. These different interventions would be required to enhance ER for each of 'Latitude', 'Resistance', 'Precariousness' and 'Panarchy' factors as mentioned in the chapter 2.1.3.

To study ecological intervention practice, Hobbs categorized ecological interventions as reactive, active, or proactive and he examined them at local, regional, or global scale

(2011). Starting from this point, to analyze ELBCP as an ecological intervention, it can be advantegous to classify them as reactive and active by scaling at local, regional, or global levels with the examples of Hobbs (Table 2.3).

To make it clear these types of interventions, while reactive interventions focus on maintaining a current ecosystem state or to stop the degrading process of an ecosystem, the main purpose of active interventions is taking steps to change ecosystem properties in a particular direction (Hobbs et al., 2011). In accordance with these definitinos, these intervention types involve the management, restoration, and conservation spectrum by avoiding the past focused aspects of restoration and conservation.

'Deepwater Horizon oil spill' can be a prominent example to examine the types of interventions. Deepwater Horizon oil spill, which caused in 2010 in Gulf of Mexico, is the largest marine disaster in history (Pallardy, 2018). The spill was resulted with huge ecological damage, environmental pollution, and socio-economical adversity (Hobbs et al., 2011). In this situation, interventions form a process from instantaneous reactive interventions to long-term active interventions. Reactive interventions need to set to work to stop the oil flow from ruptured well. According to Hobbs, this intervention is more related with engineering than ecology. He attached that: "Further reactive interventions are required in order to limit the oil's damage to sensitive ecosystems, and these may be accompanied or followed by active interventions to attempt to repair the damage caused by the oil and to reinstate aquatic systems, fishery enterprises, and other human social and economic activities disrupted by the spill" (2011).

At this point, it can be positive to make a distinction between ecological restoration and ecological intervention for this thesis. According to Aronson et al., the practice of ecological restoration focuses on restoration of local systems without concerning about socio-economic and political settings (2007). However, comprehensive and sustainable ecological interventions are also need to be broader and considered at local, regional, and global scales (Aronson et al., 2007). To consider these, ecological interventions might be restoring ecosystems in every division in the habitat, includes social, political, or biological.

Table 2.2 : Examples of different types of interventions at local, regional, and global scales (Hobbs et al., 2011).

Scale of Interventions	Type of Interventions	
	Reactive	Active
Local	Rehabilitation of a toxic site	Revegetation of inactive mining
Regional	Reduction of nitrogen inputs from agriculture at regional level	Reforestation at large scale
Global	Convention of International Trade about Endangered Species	Global Agreements of carbon emissions

Taking into account, those issues and ecological intervention policies were positive on some implementations and monitoring. It can be acceptable to exemplify major successful restoration projects to examine the case of ELBCP in accordance with the effects on ER concept. In the article "Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems," by Louis Lebel, Carl Folke et al. managing resilience in accordance with ecological systems was practically exemplified (2012).

2.4 Good Practices of ER at Regional Level

Since 2000s, some ecological intervention projects have been evaluated and app lied as a practice of ER. Many academics, foundations and university subsidiaries have assessed these projects closely. It is clear that this might investigate interactive SES in the face of disturbances and threshold changes. The good practices (at regional level), which are below, have been chosen attentively to compare the context of ER in Eğirdir Lake and its BCP with other intervention projects that is identified as quite successful by academics.

2.4.1 Great Barrier Reef, Australia:

In 2000, Great Barrier Reef Foundation was created under the establishment of UNWHC (United Nations World Heritage Convention) by some businesspersons. The foundation is dedicated to raise scientific research to protect and restore the Great

Barrier Reef, where indicates the insufficient capacity to resist against disturbances, in Australia (Great Reef Foundation, 2018). Within the scope of the intervention project, The Coral Reef's resilience was boosted and it bounced back from to survive challenges such as water quality issues and climate change by analyzing 911reefs, which are nearly 60%-100% of them were affected by bleaching events, and protecting against human interventions (Ripple, 2016).

According to Marissa L. Baskett, recent modelling shows that protection of the coral reefs and creating connectivity with the area is important to enhance the resilience of corals (2010). Appropriately, at the scale of the Great Barrier Reef, the management of an ecological intervention project must become significant to sustain the healthy ER.

2.4.2 Goulburn-Broken Catchment, Australia:

Goulburn River basin, which is Victoria's largest (1,6 million Ha) catchement and it covers 7.1% of the state's total area. The basin was restored by the Goulburn Broken Catchment Management Authority (GBCMA) in 2008/2009. The intervention was large enough to involve the conservation and intervention of systems such as fauna, flora, geomorphology, and hydrology. In addition, ecosystem services within ER of the basin have been carefully defined and are managing as important pieces of ecological, social, and economic values (CSIRO, 2003).

In 2009, Brain H. Walker published a paper of a case study to assess an ERat regional scale. According to this synthesis essay, named as 'Resilience, Adaptability, and Transformability in the Goulburn-Broken Catchment, Australia,' this intervention also focused on participative and interdisciplinary research to develop policies and practices in accordance with enhancing or maintaining of ESs. Additively, the project's outputs indicate that the intervention was successful to restore the basin's ER states (Goulburn Broken Catchment Management Authority, n.d.).

2.4.3 New England Fishery, USA:

This project can be respected as the largest intervention project as it directly planned for ecosystem services. In New England, U.S. National Oceanic and Atmospheric Administration, municipalities, regional groups like local watershed associations, and multi-national NGOs like The Nature Conservancy have worked on restoring fishery systems in the coastal area of New England.

The project has mainly focused on food, gender, and comfortable surroundings for fish of the New England. As parts of the project, dams blocking coastal rivers have been removed, the damaged spawning sites have been restored, and the pollution in the rivers of the region has been reduced (Shelly, 2013). On the other hand, as the most important part of the project, NOAA has created an interdisciplinary work team and a professional academic network. Moreover, this network and team have built sustainable ecosystems and fisheries as outputs of a healthy SES (Office of Habitat Conservation, 2018).

2.4.4 Northern Highlands Lake District, Wisconsin, USA:

This project, which was implemented by NOVA Ecological Services at lake-basin level, mainly aims to mitigate development impacts by improving the quality of wildlife habitat and reducing lakeshore erosion. The project contains the restoration of five environmentally sensitive lakes in Wisconsin. As measures of success, effectiveness of erosion control and growth of restored ER have been monitored (Meyer, 2017).

The Resilience Alliance has determined Northern Highlands Lake District as a critical region in transition from one resilience state to another and started research on socio-ecological resilience of the NHLD (The Resilience Alliance, 2002).

Allow for possibility, it can be said that, these examples have the characteristics of ecological interventions, which are described by Hobbs et al. at regional level (2011). Moreover, these examples can illuminate the practical relationship between social systems and ecological systems after combine with main intervention for the research, ELBCP.

2.5 General Attributes of ER through Good Practices

By taking the good practices above into account, all interventions have identical goals that try to manage and sustain the renewal actions as far as close to the original recovery process of the regional ecosystem. Assessing the similarities and differences of these good practices might illuminate the intervention approach to ELBCP in accordance with the ER of SES at Eğirdir Lake Basin's scale. Accordingly, the table that is shown below will give relevant information on the key details of chosen interventions by means of ER practices in these different SES (Table 2.4).

Adaptive capacity and the stability of the state of ER differ from condition to condition and region to region. Hence, the outputs of the interventions –in accordance with the ER in SES- differ by their methodology, tools of the PE, objectives, location or associates that coordinate and manage the project. When some of these details examined, it can be observable that the successful interventions that relate on ER, have a common participation with local authorities, governmental authorities, inhabitants and NGOs at the same platform. On the other hand, from the perspective of the PE, unique conservation or sustainbility plans/laws have been introduced for each intervention project. These details of the implementation process of the good practices may gain importance to the benefits and poisitve impacts on ER in SES.

Starting from this point, ELBCP as a tool for ER of SES will be assessed more illuminative and understandable from this research's perspective, because although the land characteristic and climate of the Eğirdir Basin are quite similar; the methodology, the tools of PE and stakeholders show a difference in comparison with good pracices

Table 2.3 : General Attributes of Good Practices.

Project Name	Project Location	Stakeholders	Tool of the PE	Primary Objective(s)	Type of Implementation	Methodology	Land Characteristics	Effects on SES	Benefits and effects on ER
1) Great Barrier Reef Restoration	Queensland Coast, Australia	-Australian Government -Australian Institute of Marine Science -Great Barrier Reef Foundation -Queensland Government -Australian Universities -Research Agencies -Charities	Reef 2050 Long-Term Sustainability Plan Reef 2050 Water Quality Improvement Plan; Dugong and Turtle Protection Plan	Develop a framework for understanding stressors and critical thresholds; Determine adaptive capacity of key functional groups and new opportunities for managing ESs under climate change and water quality issues; Reduce the runoff of agricultural pesticides and improve the water quality.	Ecosystem recovery and rebuilding	Assisted gene flow Assisted Evolution	Coral Reef System / Coral Sea	Conservation of numerous ESs including 1.500 species of fish. Improving water quality Conserving Endangered species Sustaining eco-tourism	In 2017, UNESCO decided not to place the Great Barrier Reef on its official list of 55 World Heritage sites "in danger." The state of the ecosystem of the barrier reef has been identified as resilient again.
2) Goulburn-Broken Catchment Protection and Restoration	Victoria, Australia	Regional Water Authorities Local Communities Government Agencies Australian Government Murray-Darling Basin Authority	The Basin Strategy Plan	Improve the waterways in the Broken Catchment with a target of improving habitat for native fish; Improve the health of the Goulburn River and wetlands; Improve the waterways to protect and enhance their environmental and recreational values.	Ecological Conservation and Restoration	A Sustainable Diversion Limit Adjustment Mechanism	Urban and Rural settlements; Irrigated Agricultural Area; Fresh-water Lake	Improving the link between vegetation, water birds, fish, and river connectivity Recognizing the Catchment's communities fall within six broad geographical areas or SES, which share environmental, economic, and social characteristics.	The water is efficiently and effectively managing for agricultural, urban, or industrial usage at basin level. ER has been started to assess at Goulburn Catchment

Table 2.3 (continued) : General Attributes of Good Practices.

3) New England Fishery	New England, USA	New England Fishery Management Council NOAA North Atlantic Salmon Conservation Organization (NASCO)	Fishery Management Plan	Conserving and managing aquaculture resources.	The Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Prevent overfishing with by sanctions Balance resource conservation with achieving optimum yield for domestic fisheries	Freshwater Lake Coastal Sea	The long-term health of a fishery is controlled by the successes and limitations of the component parts of fishery management	The ocean has started to sustain life, built an economy, and created an iconic culture The council of the project is now the resilience of deep-sea corals.
4) Northern Highlands Lake District Restoration	Wisconsin, USA	Local Government NGOs State Management Agency Local Community University of Wisconsin	the Wisconsin Wildlife Action Plan the Fish, Wildlife and Habitat Management Plan All-Bird Conservation Plan	Conserving ESs of the lake district. Restoring a functioning white-red pine forest, including significant patches of old growth, within a broader forest complex Improving the quality of wildlife habitat. Reducing lakeshore erosion.	Ecological Restoration, Conservation and Management	Ecological Assessment Framework by the MEA.	Freshwater Lake Lakeshores White and red pine forest.	-Growth and diversification of the economy and local values -Competing use of natural resources -Forest management; -Impacts of lakeshore development on water quality and fisheries; -Impacts of fish harvesting and stocking.	After the project started, the district started to catch researchers' attention. There have been a number of articles written about the area's ER in SES. There is an observation of effort's to protect the ecosystem.

2.6 Summary of the Chapter

As fauna and flora are integral parts of the biosphere, human beings are also indispensable component of ecosystems. It can be arguable that, social and ecological systems constitute a meaningful whole in ecosystem, because, when human has a power to conserve, manage, make more resilient, and restore the ecosystem, the ecosystem has a power to sustain, survive, or recover itself. Hence, the importance of the link between social and ecological systems needs to be emphasized at different levels and categorize. One of the main components of the ecosystem is clearly ER (Berkes, 2000). Based on this, other components such as ecosystem services, political ecology, etc. can be examined within the ER concept. ER concept consists of the capacity of an ecosystem to respond to a disturbance or a perturbation (Folke et al., 2002). It can be said that this definition makes ER concept more relevant and arbiter, because disturbances or perturbations are often materialized at ecosystem service components within political ecology concept.

ER is a complex study to examine, but it can be measured or examined by alterations within the scope of water quality or vegetation cover data. This measurability connects the ER concept with its practical frameworks, which are described as intervention ecology by Hobbs (1996). Intervention ecology –as different from ecological intervention- is a new strategic practice to aim reactive or active types of interventions at global, regional, or local level. Hence, the outputs of the ecological interventions can be reviewable and observable by measuring the thresholds of ER. In the light of positive outputs of ecological interventions, there are successful ecological interventions -like Great Barrier Reef in Australia- at the world.

3. "BASIN CONSERVATION PLAN" AS A TOOL FOR ECOLOGICAL RESILIENCE OF EGIRDIR BASIN'S SES

Eğirdir Lake basin is one of the 25 major basins in Turkey and contains the second largest fresh-water lake in Turkey.

The basin is 3.309 km² and an important part of Antalya Basin (19.577 km²). Beside the fishing and tourism sector, the basin has also crucial importance as a water resource for drinking and irrigation.

At this chapter of the thesis, Eğirdir Basin was chosen as an instrument to ER theory, ESs -in terms of ER- and ecological intervention practices. As an advantageous case of intervention ecology, it will be understood that, ELBCP can be considered as an important concrete step, but ineffective intervention for the ER concept and -directly- SES. In accordance with the few numbers of studies on ER of SES at regional level, this case can be one of the much debated and most illuminative tool for PE on the interdisciplinary field of ER concept and practice of SES. Additionally, "ELBCP" will be an instrument to measure, evaluate, and discuss the changeable link between social and ecological systems at the basin scale.

3.1 Location and Geographical Features of Eğirdir Basin

Geological origin of Eğirdir Basin is located at Northern Mediterranean, within Isparta Province (Figure 3.1), has been developed in a rift tectonic regime related to the Burdur transform fault (Altınkale, 2001). Tectonically originated Eğirdir Lake bottom gained its present form with karstic developments and filled with water in pluvial periods (Kazancı, 1993).

Eğirdir Basin (35° 37'-38° 16' N, 030° 44'-030° 57' E) is situated southwestern Turkey, to the east of province Isparta and it includes 81 settlements in total with Eğirdir, Senirkent, Yalvaç and Gelendost districts; and 77 different rural settlements. Land of the basin covered with steppe, scrub, and mostly agricultural land. The basin

is surrounded by Sultan Mountains (2581 m) on the north-east, Barla Mountain (2734 m) on the west, Sandıklı Mountain, Kapu and Gelincik Hills on the north-east, Davraz Mountain (2110 m) and Çirişli Mountain on the south-west, and Dedegül Mountain (2980 m) on the south-east (Serin, Babalık and Küçük, 2008).

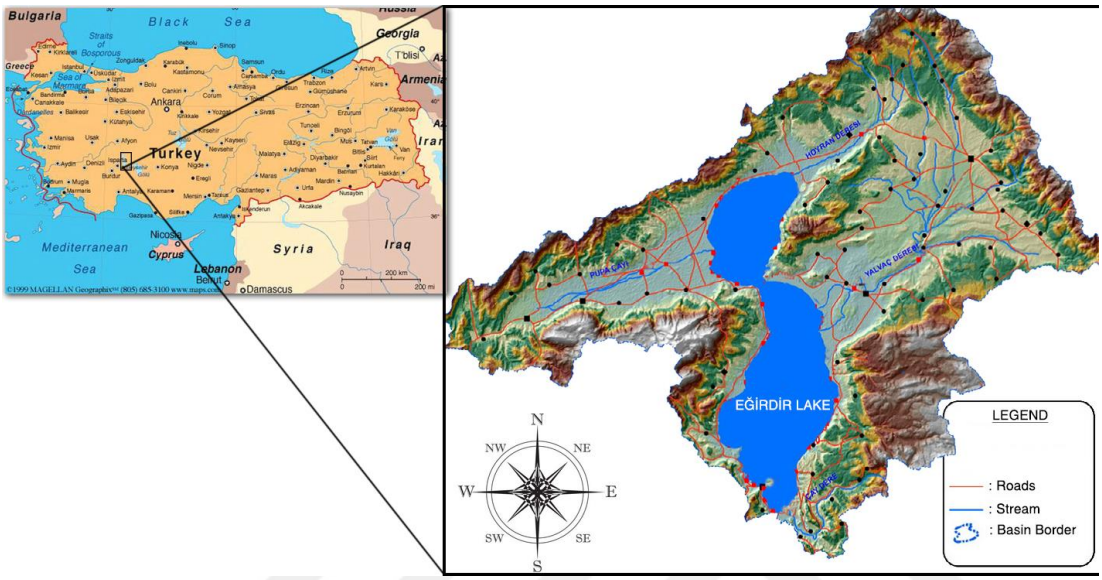


Figure 3.1 : Geographical location of Eğirdir Basin (Davraz et al., 2016).

In climatological terms, Eğirdir has a climatic range from Mediterranean climate and continental inner Anatolia climate. Mean annual temperature is 12.7 °C. January is the coldest month (mean 1.6 ° C) and July is the warmest month (mean 22 °C) (Aksoylar and Ertan, 2001). Precipitation is generally formed as orographic, cyclonic and convective (Serin, Babalık and Küçük, 2008).

All over the basin, brown calcareous forest soil on bedrocks like limestone or dolomite and brown non-calcareous forest soil on bedrocks like sandstone or claystones can be observed. Moreover, the local climate change on the north and the south of the basin, local conditions and structure of land causes the varieties of soil types.

According to Esendal (2007), the hydrological structure of the basin indicates important information about the basin. The surface of the basin is ca. 3,309 km², the surface of the lake is 468 km² with the 10-12 m depth, and the average fall is 570 mm/p.a. The surface evaporation loss is 503,78 hm³/p.a. and the income of the lake is 541,41 hm³ (Esendal, 2007). The altitude of maximum water level is 919,3 m. The most important aquifers in the basin are Uluborlu-Senirkent Lowland on the west,

Hoyran, Gelendost and Yalvaç Lowlands on the northeast. Limestones in the basin also hold ground waters, which are directed to Eğirdir Lake. The lake is fed by Pupa Stream from Uluborlu, Değirmen Stream from Hoyran Lowland and Akçay Stream from Yalvaç.

3.2 Ecosystem Features of Eğirdir Basin

Eğirdir Basin is an ecologically sensitive area with its important natural wealth in comparison with other basins in inner-Anatolian Region because the basin is connected with Mediterranean Sea by Kovada Water channel through Akçay Stream and it contains numerous living species, which has endemic characteristics (Ongan, 1970).

3.2.1 Environmental values of Eğirdir Lake

As cited above, Eğirdir Lake is crucial for the regional economy, but its ecological quality is unfortunately degraded because of the agricultural, industrial, and domestic wastes. From year of 1991 to 2016 researchers have published 34 essays, scientific papers, projects and thesis about the water quality of the Lake and its seasonal changes related to the ecological quality of Eğirdir Lake (Apaydın Yağcı and Yağcı, 2016).

According to these researches, the sudden algal population boom and unpredictable growth of fresh-water plants have been observed and these observations indicated fast alteration of ecosystem equilibrium of the lake (Erk'akan and Özeren, 2004). For instance, in accordance with the modelling study for the eutrophication control of Uluabat Lake, 4grP\m²\year phosphorus has been leaked to the lake. This situation indicates that the lake is clearly affected by the agricultural activities on the basin (Aksoy, 2006). Beside the biodiversity of the Eğirdir Basin, the lake has an important role for the inhabitants of Isparta considering its 90% of drinking water capacity.

To illuminate the perspective from eco-spatial consideration, "Preliminary Findings in Eğirdir Lake Water Quality: Assessment of In-Situ Measurements" by Şehnaz Şener can be sufficient to understand the ecological changes of water quality in Eğirdir Lake. The research was completed in 2009 May and 48 different locations were systematically monitored by taking samples. Samples were exemplified to measure temperature (°C) of the lake water, pH level, dissolved oxygen, conductivity, and depth of secchi-disc (a circular disk to measure water turbidity and transparency in

bodies of water) values. Moreover, pH, conductivity, dissolved oxygen, and temperature were measured at different 6 different locations and depth points, and graphs, in accordance with these measurements, were prepared (Şener et al., 2010).

Temperature is an important parameter to identify the bedding in lakes and it can be result of biological and chemical treatments on water resources (Ünlü, 2008). It can be said that, the temperature is a crucial part of the ecological value measurements. According to Şener et al. (2010)'s research, the mean temperature of the lake is 25,2 °C, with changing ranges from 20,8 °C to 27,7 °C (Figure 3.2) (Şener et. al. 2010). The temperature differences are related to depth to depth and the existence of underground water resources.

Another important parameter for the ecosystem and fresh-water biodiversity is pH, which is the measure of hydrogen ion concentration. PH indicates the equilibrium between acid and alkaline values and varies from 4 to 9 in natural waters (Atay and Bulut, 2005). The pH measurements of Eğirdir Lake shows an alteration between 8,67 to 9,40. These value indicate that pH of Eğirdir Lake is higher than other similar structured lakes (Eymir Lake, Caspian Sea, Reyhanlı Yenişehir Lake and Derbent Lake) (Şener et. al., 2010). As cited about temperature, pH can also be changed with depth. Therefore, it can be also seen differences in ground/underground water resources (Figure 3.3).

According to Şener's research, dissolved oxygen values formulate the concentration of substance matter in water and quality of life in Lake Biodiversity. The measures of dissolved oxygen in Eğirdir Lake indicates that the minimum value is 5,1 mg/l at the West of Hoyran location, point of 4, and the maximum value is 11,2 mg/l at the East of Hoyran location, point of 14 (Figure 3.4). Alteration of the dissolved oxygen can decrease on deeper locations of the lake (Şener et. al., 2010).

For Şener et al., the last measure method to examine the water quality of Eğirdir Lake is secchi-disk value method. The disk is generally used to determine water turbidity. The turbidity value can be differ from meteorological conditions, depth and dissolved sediments in water. Mean depth of secchi-disk is 2,1 m in Eğirdir Lake and South part of the lake has generally low depth than Boğaz part of the lake (Figure 3.6). This situation indicates that the water is clearer in Boğaz part of the lake (Şener et. al., 2010).

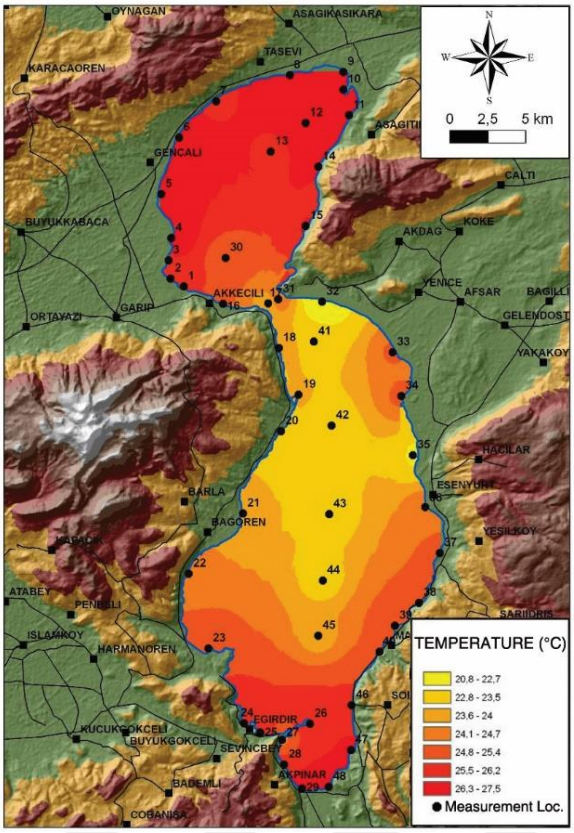


Figure 3.2 : Temperature of Eğirdir Lake (Şener et al., 2010).

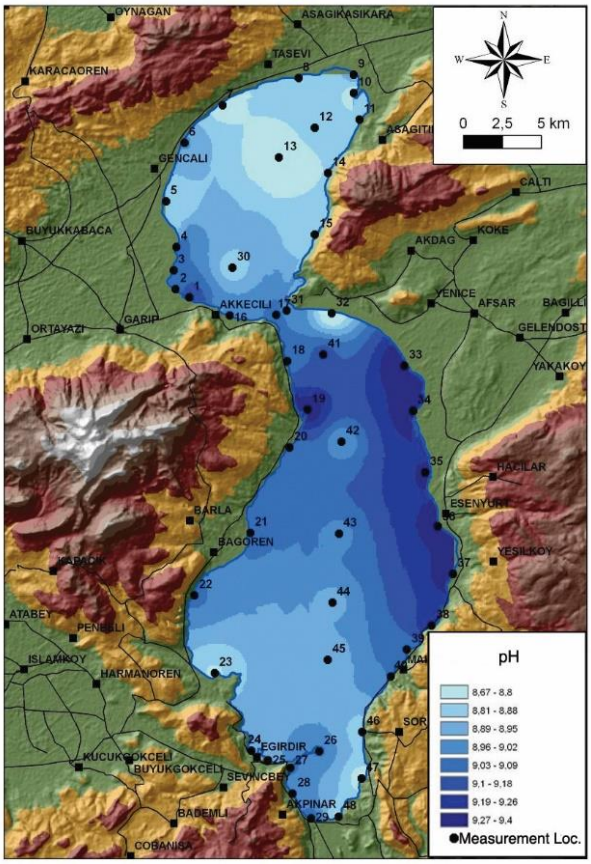


Figure 3.3 : pH values of Eğirdir Lake (Şener et al., 2010).

Another parameter, electrical conductivity, can indicate the pollution of the lake because it represents the change of sediments, which are dissolved in the water (Ünlü, 2008). It is clear that, higher value of electrical conductivity in an area shows higher pollution effect. The electrical conductivity value at the South of the lake is higher than Boğaz area and in accordance with the research; these valuations clearly indicate that Eğirdir Lake is negatively affected by pollutants, which are sourced from the South of Eğirdir Basin (Figure 3.5) (Şener et. al., 2010).

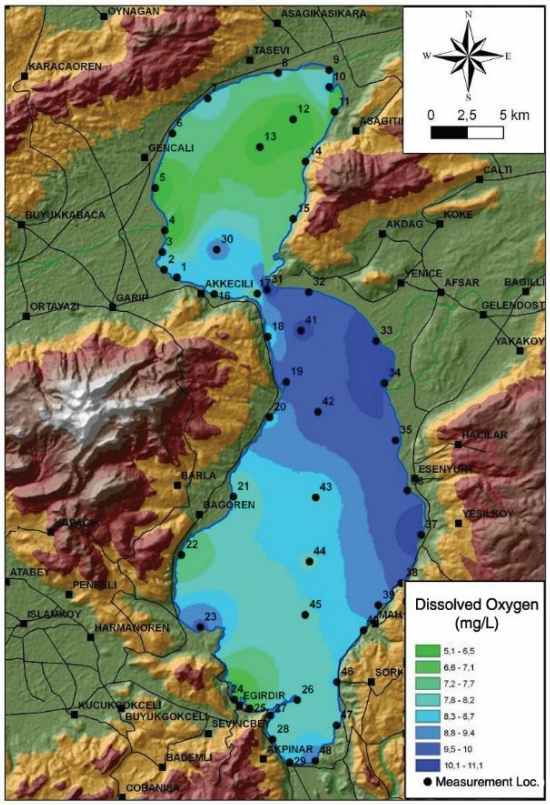


Figure 3.4 : DO values of Eğirdir Lake (Şener et al., 2010).

Briefly, according to this research in 2009, parameters of temperature (°C) of the lake water, pH, dissolved oxygen, electrical conductivity, and depth of secchi-disc value were measured at 48 different locations and 6 different depth points for each of these locations. The results, which were represented with statistical graphs and spatialize as thematic maps by GIS, indicate that the temperature of Eğirdir Lake is in the group of 1st degree water quality, the pH value is little bit higher than similar lakes with 4th degree water quality, dissolved oxygen value is in the group of 1st degree water quality with 8,3 mg/l, mean electrical conductivity value is 391 μmhos/cm, which is a result of pollution (Şener et. al., 2010).

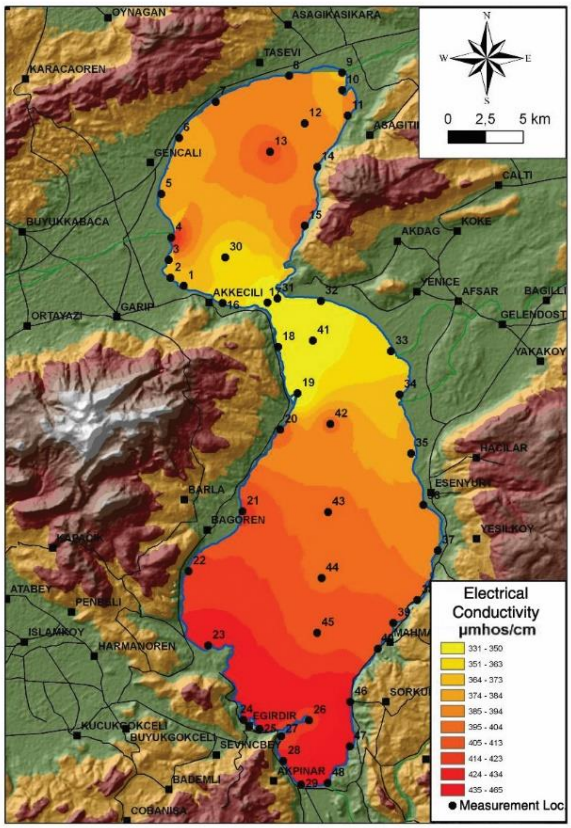


Figure 3.5 : EC values of Eğirdir Lake (Şener et al., 2010).

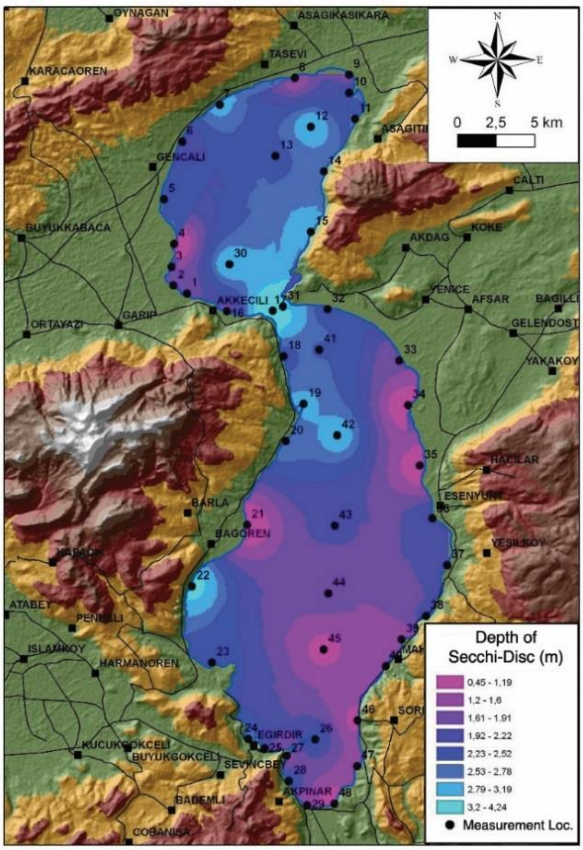


Figure 3.6 : Depth of Secchi-Disc values of Eğirdir Lake (Şener et al., 2010).

To conclude, it can be said that, Eğirdir Lake, which supplies most of drinking-water resource of Isparta, is currently under pressure by point and non-point pollutants. Because of that, effective pollutants, which are observed in different points in the lake, must be identified, periodically analyzed, and observed current situation. Moreover, the most important step to bring ecological values under control and make ER of Eğirdir Basin stronger and enduring is making ecological planning policy and management methods.

3.2.2 Biodiversity in Eğirdir Basin

Undoubtedly, climatological and geographical conditions make Eğirdir Basin a rich living space for fauna, flora and fungi species and inhabitants. As introduced above, Eğirdir Lake supports crucial drinking water for Eğirdir Basin and Isparta. The water quality, which is hanged by a thread from many pollutants, and its surround provide various living species for Eğirdir Basin. Biological and chemical characteristics of Eğirdir Lake have a place in natural succession of plankton, algae, bacteria, mollusks, fish, birds, reptilians, and mammal taxon (Ongan, 1970). It can be said that, population and variety of species can be differ in accordance with these biological and chemical factors. The taxonomy of Eğirdir Lake comprises large part of Eğirdir Basin, because of that, extensive biological research for Eğirdir Lake and its environment can illuminate the general biodiversity of Eğirdir Basin.

In 2002, Prof. Dr. M. Yaşar Aksoylar and Prof. Dr. Ö. Osman Ertan from Suleyman Demirel University built a comprehensive project for Eğirdir Lake with financial support of State Planning Organization of Turkey. The project, named "Evaluation of Hydro Biological Properties of Eğirdir Lake," has contributed to the academic literature about Eğirdir Basin with its valuable and rich content. It can be advantageous to research and examine ESs, ER and their effects to SES in Eğirdir Basin.

The project was running at 5 different locations in Eğirdir Lake between the date of June 1997 and April 1999 (Aksoylar and Ertan, 2002). During the research, biological and chemical properties of water quality, bacteriological property, chlorophyll-a and phytoplankton assortment, biomass, zooplankton taxonomy, macro-benthic taxonomy of invertebrates, population of fish and crustaceans, macro-water plants, aquatic birds, and amphibian fauna were analyzed and studied.

According to Aksoylar and Ertan, the results of the examination can be viewable as below:

Total number of bacteria is 0,8x10-9x10³ cfu/ml (colony forming unit per milliliter), number of coliform bacteria is 0,3x10-1,3x10³ / 100 ml and number of faecal streptococci is 3,8x10-1,6x10³ / 100 ml.

In accordance with algal flora taxonomy, 34 species of Bacillariophyta, 17 of Chlorophyta, 8 of Cyanophyta, 2 of Pyrrophyta, and 2 of Chrysophyta were detected. Most common species are Ceratium hirudinella, Dinobryon sertularia, Dinobriyon tabellaria, Synedra ulna, Pediastrum duplex, Pediastrum boryanum, Anabaena affinis, Oscillatoria sancta and Zygnema sp. Mean value of chlorophyll-a is 5,56 mg/m³, density of phytoplankton is 4,1x104 -180x104 cell/liter and biome is 40-2451,4 µg/l.

On the research of zooplankton, 41 species of Rotifera, 10 species of Cladocera, and 4 species of Copepoda were observed. Mean density of zooplankton is 26011 org/m³ with 78% of Rotifera, 12% of Veliger, 10% of Copepoda and 0,26% of Cladocera.

The research about macro-benthic fauna shows that 2 species of Bryozoa, 2 species of Annelida, 1 species of Hirudinea, 14 species of Mollusca, 2 species of Bivalvia, 3 species of Arthropoda, 2 species of Trichoptera, 2 species of Amphipoda, 1 species of Porifera, 1 species of Cnidaria, 2 species of Plathelmintes and 1 species of Nematoda taxons were indicated. Most dominant species respectively are Gastrupoda (gastropods) (24582 individual/m²), Bivalvia (5473 individual/m²), Oligochaeta (segmented worms) (1606 individual/m²), and Bryozooa (moss animals) (788 individual/m²).

There are 1148 different fish species caught during the research, which have economic and non-economic value, in Eğirdir Lake. These species include 641 species of Sander lucioperca (zander), 471 species of Carassius auratus (pond fish), 13 species of Cyprinus carpio (carp), 8 species of Tinca tinca (tench), 8 species of Oncorhynchus mykiss (salmon), and 3 species of Vimba vimba (egrez). Moreover, crayfish is another important species in Eğirdir Lake and 1800 Astocoidea (crayfish) caught during the examination.

In Eğirdir Lake, 71 species of aquatic plants were located. Generally, Phragmites australis species spread on the lake surface (10-1000 m²) and Chara sp. cover all over

the lakebed. Potamogeton, Myriophyllum and Valisneria sp. are another aquatic plant species observing in Eğirdir Lake.

Finally, there are 37 different bird species and numerous amphibious species were qualitatively examined as a part of the research (Aksoylar and Ertan, 2002).

Within the scope of outputs of the project, 'Evaluation of Hydro biological Properties of Eğirdir Lake,' endemic and non-endemic species in Eğirdir Basin does not constitute the crucial indicator for biodiversity change, because, they do not show any critical alteration year-by-year (Aksoylar and Ertan, 2002). However, E. coli bacteria were detected at the front of lakeside and this is an important parameter of that sewage system has leaked to the fresh-water of Eğirdir Lake. For this reason, biological property of water quality is not 1st quality any more.

Moreover, population of Procladius sp. (non-biting midge), which is an important indicator for clean water systems, have decreased, and sprawl of P. australis (wetland grasses), which can be seen at the edge of agricultural areas, have decreased (Aksoylar and Ertan, 2002).

To conclude, according to scientific findings of the project, human-made factors are number one negative effects to the conservation of ER and the sustainability of Eğirdir Lake biodiversity. As reasons of these factors, chemical agricultural activities, irregular hunting activities in lakes and forests, human-made ecosystem interventions, increasing domestic wastes and ecological-enemy planning, such as filling of lakeshore, and unplanned urbanization, etc. for Eğirdir Basin have become a threat for the bio-diversity of Eğirdir Basin.

3.2.3 Significance of ESs in Eğirdir Basin

As stated at 2nd chapter of the thesis, MEA (2005) designated ESs, which are globally based on the sustainability of ecosystems. It can be advantageous to determine the ESs in Eğirdir Basin with MEA's classification and İlke Albayrak's PhD thesis, named "Applicability of ecosystem services based watershed management model in Istanbul-Ömerli Watershed Case" (2012). According to Albayrak's study, potential ecosystem services in Ömerli Basin have been classified with land cover types, which are forest, heathland, surface water, meadow, agricultural lands, and urban green areas. Therefore, same land types for Eğirdir Basin and main ecosystem service classification of MEA (2005) will recruit the ecosystem services for Eğirdir Basin.

Regrettably, Eğirdir Basin's ESs have never been studied in academic literature. However, there are many studies about fishery, forestry, and urban areas. For instance, since 1940 to 2016, 32 scientific essay, 38 symposium papers, 14 scientific projects, 15 thesis have been proceeded about fishery in Eğirdir Basin (Apaydın Yağcı and Yağcı, 2016). On the other hand, as statistically cited at 4th chapter, there are agricultural inventory analysis organized by Directorate of District Food Agriculture and Livestock.

As can be seen at table 3.1, forestland cover has the potential to provide 16 of 17 ESs in Eğirdir Lake Basin. On the other hand, shrub land covers have 9, lake has 11, meadowland covers have 8, cultivated areas have 7, and urban green areas have 6 of 17 ecosystem services.

Table 3.1 : Significance of ecosystem services in Eğirdir Basin (Originated from Albayrak's thesis).

	ECOSYSTEM SERVICE	**LAND COVER**					
		Forest	Shrub land	Lake	Meadowland	Cultivated Area	Urban Green Area
Provisioning Services	Food	+	+	+	+	+	
	Fiber	+	+			+	
	Genetic Resources	+	+		+		
	Biochemical, Natural Medicines, Pharmaceuticals	+	+		+	+	
	Fresh Water	+		+			
Regulating Services	Air Quality Regulation	+		+			+
	Climate Regulation	+		+			+
	Water Regulation	+	+	+	+		
	Erosion Regulation	+	+		+		
	Water Purification and Waste Treatment			+			
	Disease Regulation	+		+			

Table 3.1 (continued) : Significance of ecosystem services in Eğirdir Basin (Originated from Albayrak's research)

	Pest Regulation	+				+	
	Pollination	+	+		+	+	+
	Natural Hazard Regulation	+		+			
Cultural Services	Spiritual and Ethical Values	+		+		+	+
	Aesthetic Values	+	+	+	+	+	+
	Recreation and Ecotourism	+	+	+	+		+

It can be established a connection between ESs and ER concept and their spatial relation throughout the land cover assessment methodology. As a result of, land cover change, heterogeneous ecosystems and landscape changes, such as potential state changes on ER can be assessed. Land cover change is generally used for a mean-variance analysis in convert with a analysis on spatial-persistence (Cui, et al., 2013).

Within the scope of this study, the changes on vegetation patterns, significance, or meaning of land-cover for the SES in the basin and heterogeneity can be measured with the land cover for ER of the basin. On the other hand, using a SES framework to analyze the threshold dynamics underpinning the ER in such land use changes. At this point, it advantageous to review some researchers' studies. According to Arttu Malkamaki (2016), ER of environmentally sensitive livelihood has been suppressed firstly by changes on land use. Accordingly, certain outcomes of the threshold dynamics through the land cover changes in Eğirdir Basin introduce the resilience of SES.

In this direction, the interconnection between Eğirdir Basin's SES and land cover changes can be evaluated with two Corine maps of 1990 (Figure 3.7) and 2012 years (Figure 3.8).

When the broad changes on land cover are examined, it can be seen that some states of basin ecosystems changed in 22 years. The general features of the land cover change:

1. Natural grass land to bare rocks

2. Permanently irrigated land to fruit trees and berry plantations
3. Agro-forestry areas to fruit trees and berry plantations
4. Pastures to complex cultivation patterns
5. Complex cultivation patterns to pastures
6. Broad leaved forest to sparsely vegetated areas

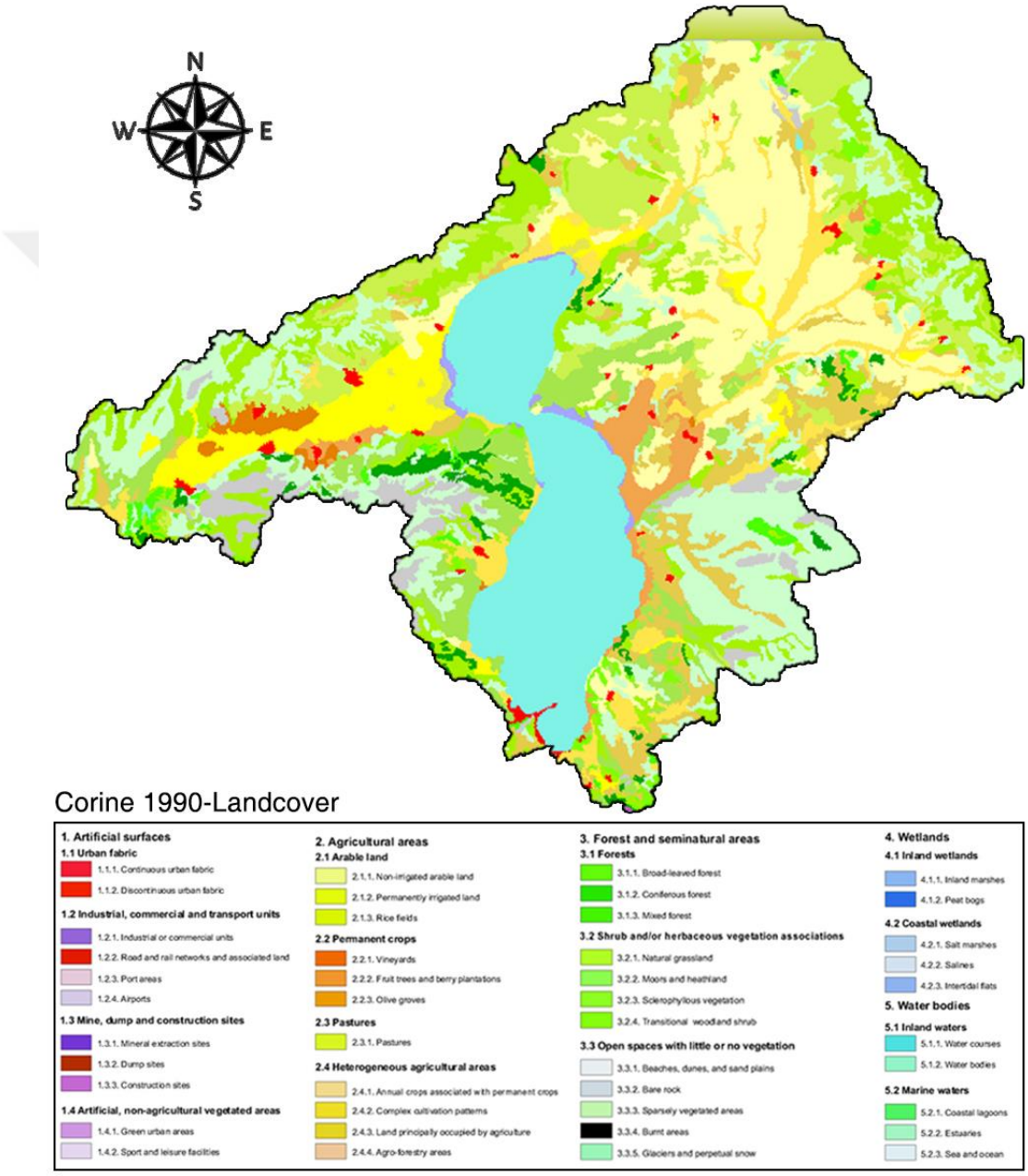


Figure 3.7 : 1990 Corine / Land Use Land Cover of Eğirdir Basin.

Regrettably, to compare measure and evaluate the land cover before and after the ELBCP, the updated version of CORINE-land cover has not been initiated yet.

However, it can be advantageous to assess the changes from 1990 to 2012. When the changes over the course of 22 years are examined, there are sufficient spatial adjustments on the basin through the ESs in the scope of ER concept.

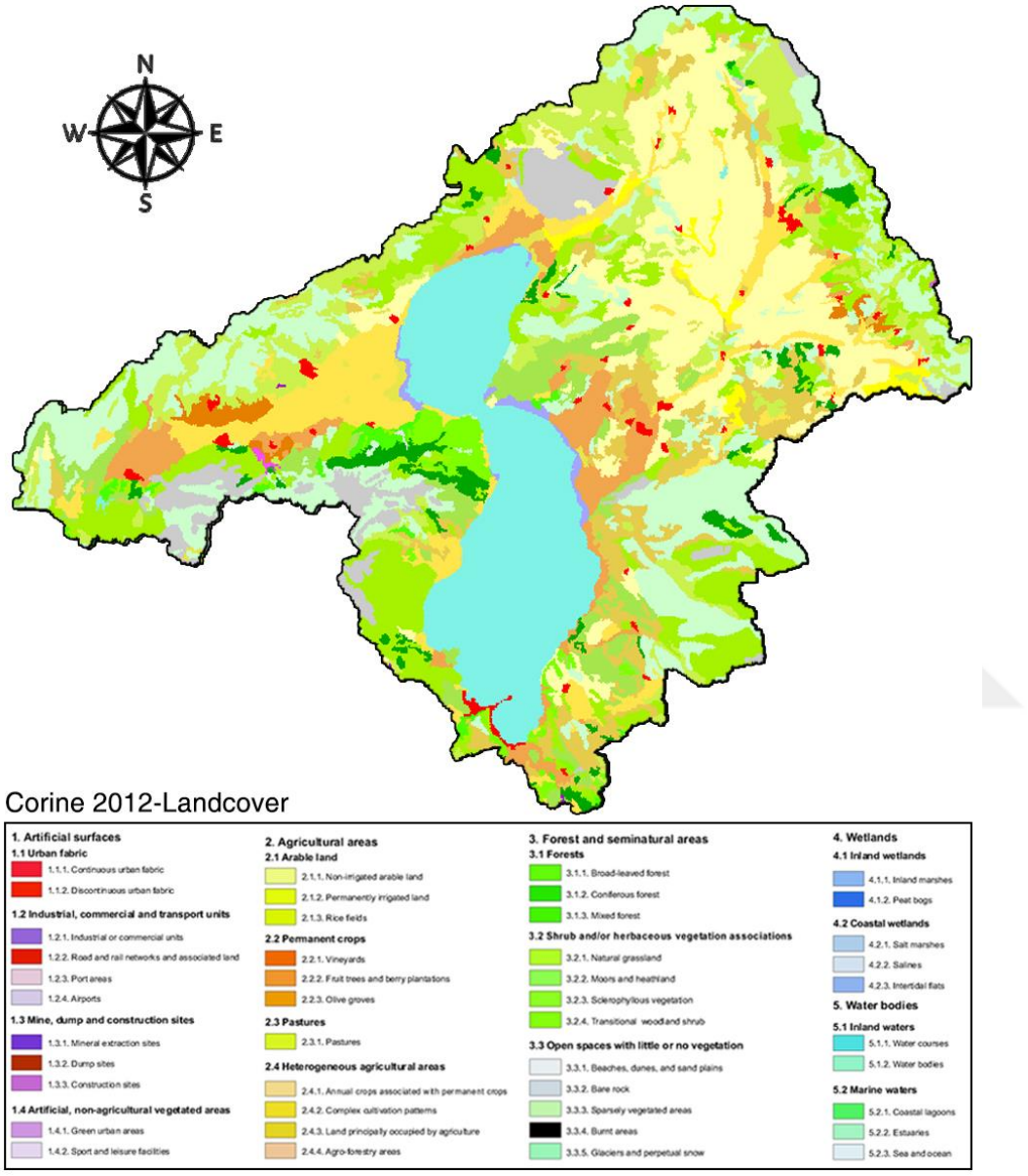


Figure 3.8 : 2012 Corine / Land Use Land cover of Eğirdir Basin.

Mainly, the northern part of the basin shows a change in accordance with the land cover. Especially, 'the changes from natural grass land to bare rocks' and 'the changes from broad leaved forest pattern to sparsely vegetation area' can be considered as a crucial indicator that demonstrates the sudden state changes on ER as a result of the decrease on the ecological features of natural state of the system. On the other hand,

'the changes from agro-forestry areas to fruit trees' illustrate the changes on ESs and their resilience on the basin, because the natural landscape of the region was changed from its state to the rural landscape belongs to social systems.

Table 3.2 : Land cover change from 1990 to 2012

Code	Description	CORINE Land Cover 1990	CORINE Land Cover 2012	Land Cover Change (Ha)	Land Cover Change (%)
211	Non-irrigated Arable Land	48306,50	44046,80	4259,71	-8.8%
212	Permanently Irrigated Land	15721,51	1376,92	14344,59	-91.2%
221	Vineyards	2525,44	2017,66	507,78	-20.07%
222	Fruit Trees and Berry Plantations	7204,03	7015,10	188,93	-2.62%
231	Pastures	1715,85	1450,25	265,60	-15.47%
242	Complex Cultivation Patterns	17146,08	10786,58	6359,51	-37.09%
243	Land Principally Occupied by Agriculture with Significant Areas Of Natural Vegetation	21671,74	17328,57	4343,18	-20.04%
311	Broad-Leaved Forest	2322,00	2081,99	240,01	-10.33%
312	Coniferous Forest	5959,32	5430,76	528,57	-8.86%
313	Mixed Forest	2905,09	1060,13	1844,96	-63.50%
321	Natural Grassland	32169,55	24874,04	7295,52	-22.67%
323	Sclerophyllous Vegetation	19041,88	13632,54	5409,34	-28.40%
324	Transitional Woodland-shrub	33427,40	22435,57	10991,83	-32.88%
333	Sparsely Vegetated Areas	50509,66	38004,35	12505,32	-24.75%
411	Inland Marshes	1565,51	1430,62	134,90	-8.61%

Moreover, the relationship between ESs and the changes on SES can be measured with land cover changes with CORINE land cover data. Accordingly, with by GIS, 1990 and 2012 data (in hectare) was compared to extract the changes on land cover as can be seen at Table3.2.

When the most dramatic changes are aligned, it is clear that 'permanently irrigated lands' with 91.2% (14.344 Ha), 'Mixed Forest' with 63.50 % (1.844 Ha), and 'Complex Cultivation Patterns' with 37.09% (6.359 Ha) are the most important three

areas playing a crucial role on the changes of ER in SES at basin level. On the other hand, from the broad perspective, the decline of agricultural lands demonstrates the decrease of the qualification and quantity of ESs at basin level.

According to the concept theory that argues the link between land cover and the changes on ER, these simple changes for 22 years can be considered as a signal for regime shifts as stated on the part of the EWoRS methodology. Accordingly, although, there is insufficient land cover data after ELBCP, it can be analyzed the impacts of it on the ESs and relative changes of ER with by healthy land cover data.

Correspondingly, the economic structure, related to the regional ESs and agricultural structure, needs to be reviewed through the Eğirdir Basin. Hence, the assessment of ELBCP will be more understandable and scientifically reasoning.

3.3 Economic Structure of Eğirdir

It can be said that, the organic relationship between economy and ER – as the same ling among the SES- has a common network through ESs. Eğirdir has also a powerful and historically rooted economic structure, which is ES and agriculture oriented. Therefore, economic structure of Eğirdir and its basin is a crucial instrument for this research.

Eğirdir's history dates back to Arzawa Kingdom's Anatolian settlements in 2000-1200 B.C. and Eğirdir has always been an economic focal point along the civilizations of Hittites (1800-1200 B.C.), Phryiggian (750-690 B.C.), Lydia (690-547 B.C.), and Persian (547-334 B.C.), Macedonia, Roman, Seljuk and Ottoman Empire ("Eğirdir'in Tarihi", 2017). Especially during the era of Ottoman Empire, Eğirdir has an important economic role with its powerful Anatolian bazaar. According to the Annals of Konya Province in Ottoman Era (2012), Eğirdir has 864 houses, 4 inns, 3 hammams, 211 shops, 1 mill, 4 ovens, and 3 coffee houses (Mızrakçı, 2006).

Agriculture takes an important place in Eğirdir Basin's economy. Especially Bağlar region, which is located on south of the lake, contains agricultural products, such as apple, grape, quince, medlar, walnut, peach, apricot orchards take place in the basin. 10% of Turkey's 2.500.000 ton apple has been produced in Eğirdir Basin (TUIK, 2014). Fertile soil of the basin makes Eğirdir the most active center for apple production and export. In recent years, annual production of apple provides added

value to the national economy ("Eğirdir'den Ülke Ekonomisine 400 Milyon Lira Katma Değer", 2016).

Economy of fruit, rose, cereal, production in Eğirdir Basin also contributes to regional employment on the sub-economic activities of storage, marketing, packaging, and cultivation (Burak and Ergün, 2001).

One of the most important agricultural products in Eğirdir Basin is crayfish (*Astacus leptodactylus*) in addition to zander, cyprinus, and salmon fish (Figure 3.10). 20% of these fish stocks in Turkey have been provided from Eğirdir Basin and this percentage makes Eğirdir Lake's most important provision of food service in the Inner Anatolia ("Ekonomik Yapı", n.d.). Although, fishing activity in Eğirdir is a crucial part of local economy, endemic and non-endemic fish taxonomy has been declining. The reasons of fish population decline after 1980, are results of human-made interventions such as releasing zander fish to the lake and crayfish plague kind of fish diseases (Aksoylar and Ertan, 2002). For instance, between the years of 2005-2013, crayfish could not be caught and not economically used due to the crayfish plague (aphanomycosis) (Timur et al., 2010).

Third, although husbandry is not prevalent, it is another important agricultural activity in rugged terrains, woodlands, and heathland areas of Eğirdir Basin. Considerable amount of hair goat and angora goat have approved to grow and breed under these proper conditions. According to Turkish Statistical Institute, 49.353 individual hair goats were produced annually 2.779 ton milk (2017).

While Eğirdir inhabitants professed small industry activities such as fabric weaving, leatherwork, producing of salt, wine, scent, and color plants, etc. since the first years of the republic, textile industry, carpet business, crayfish, fish, fruit, rose and rose-oil production, leather, and cement, flake board, barite, marble, timber industries have been dominant as reflection of old industries. As centerpieces of Eğirdir Basin's economy related to ESs, well-equipped industry depots and plants can be listed as:

(1) Eğirdir floor plants,

(2) Cold-storage depots for fishery, fruit and rose stocks,

(3) Asya and TREKO fruit juice plants and

(4) Aquaculture resource plants for taken crayfish ("Ekonomik Yapı", n.d.).

Figure 3.9 : Frosted surface of Eğirdir Lake during the fishing season (Doğan Press Agency, 2017).

Aquaculture resource plants and cold storage depots in Eğirdir Basin are being used to sort, package, and commercialize the source to be transported to national and international markets. Second, fruit juice plants, which are generally based on apple, apricot, and cherry, and cold storage depots for all kind of fruit productions in the basin, have provided services with their high-capacity equipment ("Ekonomik Yapı", n.d.).

Besides the cosmetic industry based on rose and rose-oil products, textile industry (such as, carpeting, wool, cotton, leather industry) and mining industry for marble, pumice stone production, etc. and forest product industry, small industrial area in Eğirdir and Yalvaç District can be counted as advantageous economic facilities in the Eğirdir Basin. These small industrial areas frequently provide employment opportunity to furniture manufacturing, carpentry, and vehicle repair shops ("Ekonomik Yapı", n.d.).

Eğirdir Basin has powerful characteristics of tourism because of the vicinity to Antalya being primary touristic center of the country. The research area has many historical and socio-cultural attraction points, inns, public baths, mosques, madrasas, and archeological ruins. The city center of the basin is located on the historical route of the Silk Road. Additionally, the area is located on the travel route of missionary St.Paul; and providing relevant camping sites for travelers for this purpose (Çatal, 2010).

Unfortunately, the level of domestic and foreign tourist numbers does not indicate well the significance of the area deserves. According to statistics of Eğirdir District Directorate of Culture and Tourism, in 2009, total number of accommodated tourists is 77.624 and total number of daily tourist numbers is 86.820 (Çatal, 2010).

The natural values of Eğirdir have been actively used by many national and international sportsmen (Figure 3.11). For instance, Mediterranean cup sailing race, international triathlon races were organized on the lake in 1997. On the other hand, while parasailing, Jet Ski, paddleboat, and banana are active water-sports on the surface of Eğirdir Lake, mountaineering, spelunking, orienteering, trekking, and climbing are other active outdoor sports, organized in the context of cultura ESs in Eğirdir Basin (Çatal, 2010).

In addition to these, Eğirdir District reached Cittaslow status in 2017 (Ongun et al., 2017). It is clear that this status can be perceived as considerable opportunity for Eğirdir inhabitants, to disseminate Eğirdir District's, and the basin's multi-dimensional tourism potential. In parallel with ethic values of ecology, Cittaslow network, which is overlapping with rural tourism, has a place in rural development and sustainable tourism development in Eğirdir Basin (Ongun, 2017).

To conclude, industry, agriculture, and/or tourism based economy of Eğirdir Basin is strongly related with the sustainability of ESs provided by Eğirdir Basin. It can be accordingly said that, conserving, restoring, and sustainably managing ecosystems and ER will recruit to improve the sustainability of SES, because economy of all basin systems on the globe –like Eğirdir Basin- is interrelated with ecosystem and its services.

Figure 3.10 : 14th Triathlon races on Eğirdir Lake (Turkish Triathlon Federation, 2016).

It can be said that, central government authorities, local governments, NGOs, and other related stakeholders are aware of the potential on economic structure of the basin.

3.4 Environmental Interventions for Eğirdir Basin before ELBCP

Semi-independently from environmental decisions, there are urban and regional plans and reports, which present the economic, logistic, touristic, and social structure spatial decisions for the region. The essential plans for Eğirdir and Eğirdir Basin can be listed as below:

- Action Plan for Turkey's Tourism Strategy in 2007;
- Eğirdir Lake Management Plan in 2008;
- Tourism Potential of Eğirdir District in 2011;
- 2013-2023 Nature Tourism Master Plan for Isparta Province;
- "1/100.000 Scaled Environmental Master Plan for Antalya, Burdur and Isparta Planning Region" in 2014;
- 2016-2023 Eğirdir Rural Development Plan;
- 2018-2023 Investment Support and Promotion Strategy for Isparta Province.

Unfavorably, these plans and strategies have not taken a concrete step for directly environmental issues and indirectly the sudden changes of ER at the basin level. However, particularly in the scope of another framework, Turkish Government evaluated Eğirdir Lake as a 'hot point' based upon the importance of the lake as a drinking water resource. As cited before, domestic wastes and wastewaters, which are

discharged without being treated, to the lake, has leaked into the water and they affect Gelendost, Senirkent, Uluborlu, and Yalvaç Regions in terms of SES. As governmental authorities approve, *E.coli* Bacteria types, TN (Total Nitrogen) and TP (Total Phosphorus) concentrations have increased and influenced negatively the lake's ecosystem (Göller ve Sulak Alanlar Eylem Planı, 2016).

On the other hand, annual disinfestation against pests and fertilizers have disadvantage to the ecosystem of Eğirdir Basin. During the site visit as part of the thesis' case study research; discharged tanks, broken/disposed old equipment/tools, trash and boxes of pesticides were observed on the surface of the lake, streambeds, and water channels (Figure 3.12). It can be said that chemical agricultural activities to produce apple, apricot, and cherry faster than usual affect negatively to the environment.

Figure 3.11 : Disposed pesticide packages and trash around the Eğirdir Basin (taken during the site visit)

Lastly, active industry enterprises (organized industrial site, small industrial site, and individual plants) on the basin pose a threat to the basin's ecosystem as well. Individual plants are the major reason of the pollution as they are related to leather industry and rose-oil production plants, which are located on the long-range protection zone of the basin (Göller ve Sulak Alanlar Eylem Planı, 2016).

Taking into account, the threats as cited above, which were lately observed, analyzed, and evaluated by government authorities, NGOs, scientists, and inhabitants, have initiated environmental interventions to conserve, restore, and sustainably manage Eğirdir Basin.

Eğirdir Lake Special Provisions Plan (ELSPP)

Therefore, with the 2002, Eğirdir Lake Special Provisions have been published by the Ministry of Forestry and Water Affairs. The main goal of the ELSPPs is to protect drinking water quality of Eğirdir Lake and provide sustainable use. ELSPPs impose sanction about construction of infrastructure systems, standardization of discharging of wastes, closed and drip irrigation systems for agricultural water use, biological and biotechnological methods for agricultural production instead of chemical pesticides; banning activities like fuel, bilge or wastewaters from boats, invasive species in the lake, green-belt zones, and protection zones of the basin (*Eğirdir Gölü Özel Hükümleri, 2004)*.

The crucial decisions, as parts of the ELSPPs, are undoubtedly imposing severe penalties to chemical pesticide users and removing or disinfection interventions against invasive species in the lake. Although, Eğirdir Lake Special Provisions Plan can be considered as a positive start to restore ER of the basin, they must be questioned that how the ELSPPs sufficient and sustainable are for the ecosystem, because as can be understood, this instrument of PE was unsuccessful as an ecological intervention in terms of ESs at the basin.

"Seven Colored Life to Seven Colored Lake"

In 2008, WWF Turkey and Siemens Home Appliances have attempted to protect Eğirdir Lake with a comprehensive project, named "Seven colored life to seven colored lake." Starting point of the project was the report of 'pollution situation and pollution sources modelling in Eğirdir Lake.' The project mainly purposes to develop sustainable implementations to fisheries, fruit agriculture, and tourism. Additionally, the project aimed to improve awareness of the people and capacity of the inhabitants through training programs for ecosystem laborers ("Eğirdir'in Geleceği için Umut", 2012).

The fact that, this project is an advantageous step for the Eğirdir Basin's ecosystem, because WWF and Siemens play an associative role for Isparta Chamber of Industry and Trade, Isparta Provincial Directorate Of Environment And Forestry, and Isparta Governorship. Workshops, trainings, and seminars were organized for organic agriculture applications, tourism plans, and sustainable usage of ecosystem services by government authorities and NGOs. However, the most important contribution of

this project is to initiate the most extensive environmental intervention, named ELBCP for the basin.

3.5 Eğirdir Lake Basin Conservation Plan

ELBCP is comprehensive in terms of political ecology perspective. It was prepared by superposing WWF and Siemens's project and Eğirdir Lake Special Provisions. The plan has started under the leadership of Turkish 'Ministry of Environment and Forestry, Directorate General of Nature Conservation and National Parks', 'Governorship of Isparta', 'Isparta Provincial Directorate of Environment and Forestry' and with the support of WWF Turkey and Siemens (Gök, 2017).

The plan mainly focused on reduction of lake pollution, sustainability of Eğirdir Lake Fishery, increasing eco-tourism, agro tourism, and faith tourism, sustainability of fauna and flora biodiversity in Eğirdir Basin, reinvigorate the ecosystem services in the basin. Although it will be understandable that ELBCP is an important attempt to try to restore socio-ecological systems at Eğirdir Basin, it is not exactly prosperous PE instrument in the long term. Therewithal, the insufficient data on the active participation and roles of stakeholders can be considered as default negative feature in accordance with the ER concept in the thought of PE. Nevertheless, to understand the SES framework of the intervention, the time and work plan of ELBCP must be analyzed and interpreted in the scope of ER.

3.5.1 Schedule of works and their impacts on Eğirdir Basin's ER

As it can be seen at Appendix B, action plan for ELBCP and applicability of the project was set until 2020. Although, the plan involves a wide-ranging aim for Eğirdir Basin, the bigger part of actions is not applicable for the sustainability, which is an independent and major requirement for the ER at basin level. For instance, according to work plan, the action of "running of re-cycle and compost facilities" seems that it was set until 2014. The implementation of the action is not yet known for now, but if crucial progresses, like the running of recycle and compost facilities was halted, it can be said that ELBCP might not be evaluated as a good practice of ecological intervention for ER in SES.

Appendix D (work plan for ELBCP and their impacts on Eğirdir Basin's ER) can be used to evaluate the whole project within a timeline and to understand the impacts of ELBCP work plan on Eğirdir Basin's ER clearly.

At the work plan table, the actions that affect positively the ER of SES in Eğirdir Basin are marked as "+" in accordance with their year of implementation. When the table, which can be seen at appendix d, considered, it can be understood that the relevant intervention at the work plan can help to conserve, sustain, or restore the local state of ER at Eğirdir Basin. For instance, 'forestation and rehabilitation' work would make a significant contribution to the resilience of the forest ecosystem. Moreover, as mentioned above, the actions, which are not planned after a specific year, are marked as "NA (Not Applicable)." For instance, under the work item of "Forestation, Erosion, and Pasture Improvement," "Pasture Improvement" was scheduled only for three years and after 2014, any scheduled action for the item is not available as stated in the official work plan. On the other hand, the interventions that are not effective positively or negatively for ER in SES are marked as "0."

Theoretically, although the regenerative impacts of ELBCP on regional ER in SES can be seen at this table, the practical framework of the project may seem different. The interviews during the field study in Eğirdir Basin, indicated that the implementation of the action plan has been partially interrupted due to some bureaucratic reasons such as, counter claims of local authorities, miscommunication among institutions and organizations (Gök, 2017). To assess the achievement and success of ELBCP in accordance with ER in SES, the project will be evaluated at the conclusion part with SWOT Analysis, EWoRS, and field interviews.

3.5.2 Protection zones for the conservation plan

Within the context of BCP and Special Provisions Project, five different protection zone (Figure 3.10) were specified to implement the environmental interventions.

3.5.2.1 Lake green belt zone

The zone was defined within the range of 30 meters from the lakeshore line. Within this zone, all private-registered lands, except village settlements were expropriated and the construction of any new structures were banned. In addition, all types of native plants and landscape characteristics within this zone have been protected. According

to interviewees of Eğirdir Basin, the most important sanctions of BCP are imposed the actions that affect positively the ER of SES in Eğirdir Basin.

3.5.2.2 Strict protection zone with geological bed

This zone involves water resources of Taşevi, Aşağıtırtar, Kayaağzı, and Kemerdamları. In the zone of protection, mining, agricultural and construction activities have been banned and all types of native plants and landscape characteristics within this zone have been protected.

3.5.2.3 Lake protection zone:

Lake protection zone was defined within the range of 270 meters from the green-belt zone line. Operation of cold storage depots were banned, only they get permission if they have waste watertight infrastructure and connected to sewage systems. Additionally, construction of industry or tourism facilities, grazing and new agricultural activities have been banned too in this zone as well. The existing agricultural activities were allowed under the conditions of organic agricultural production. Moreover, concrete material use for the construction of recreational facilities, playgrounds, or park areas together with any new motorway route constructions have been banned too within this lake protection zone.

3.5.2.4 Short distance protection area

This zone was lined off within the range of 700 meters from the strict protection zone. Construction of any gas station, carwashes, stopovers or chemicals depot; storage and disposal of wastes; any tourism and industry facilities; uncontrolled grazing; and buildings, except temporary and public buildings for villages have been forbidden in the boundaries of short distance protection area.

3.5.2.5 Middle distance protection area

This area was defined within the range of 1000 meters from the short distance protection area. Inside of this zone, it is prohibited to build new industry facilities, car-washing facilities, stopovers, mining facilities and fuel stations; and storing or disposing waste. On the other hand, buildings, which are essential for rural settlement development and/or tourism facilities –with less than 100 beds- on condition that they

have waste discharge standardizations, can be constructed within this zone. Moreover, existing agricultural lands should be transformed into organic agricultural lands.

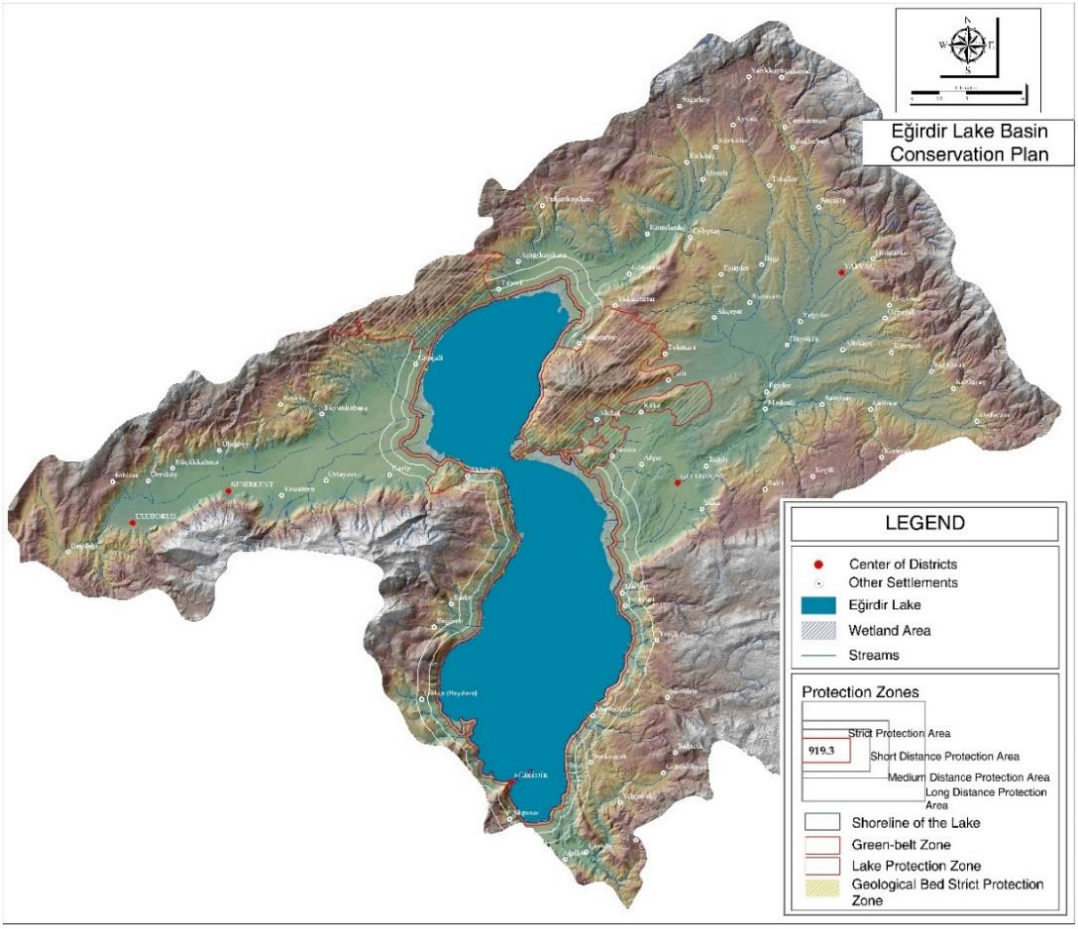


Figure 3.12 : Protection zones of Eğirdir Basin ("Eğirdir Lake Basin Conservation Plan," 2013).

3.5.2.6 Long distance protection area

Long Distance Protection Area was defined within between Middle Distance Protection Area and the border of Eğirdir Basin. Different from other protection areas, this zone is within the boundaries of permits to construct new tourism facilities with 200 beds, small-industry sites, organized industry sites, singular industrial facilities, which may have hazardous wastes and industrial wastewaters.

Although, special provisions have started in 2002, there are no any researches, projects, or thesis about ecological interventions on Eğirdir Lake or Eğirdir Basin yet. The success, political determination, and sustainability of ELBCP are essential for ER and legibility of ecosystem services of Eğirdir Basin. To discuss these, it might be

constructive to receive opinion about the intervention from academics, researchers, government authorities, agriculturists, fisheries cooperative, and municipalities.

As mentioned above, in the scope of this thesis, the field research to Eğirdir Basin was organized in May 2017. During the research, alongside the data collection about the basin and its ecosystem services, there have been interviews, discussions, and comments on environmental interventions about Eğirdir Basin.

As part of the interviews and discussions, there have been three different opinions about BCP. Firstly, positive opinions were generally expressed by fruit farmers within the basin, tourism facilities, Fishery Cooperative of Eğirdir, Mr. Veli Gök (District Head of AKP Eğirdir), Eğirdir Directorate of District Food Agriculture and Livestock and Eğirdir Aquaculture Observation Station. According to Dr. Meral Apaydın Yağcı and Abdülkadir Yağcı from Aquaculture Observation Station and Suleyman Demirel University, Department of Aquaculture, "after the conservation plan, the lake has been returned into itself again" by implying to biodiversity of the lake (2017).

Second opinion for the interventions is neutral opinions. Grain farmers, agriculture based industry sectors, animal breeders, and Eğirdir District Directorate of Social Security Institution. Director of Eğirdir Social Security Institution claimed that "statistics of employment on fishery and agriculture has stable progress after the provisions" (2017). The opinion of Directorate of Eğirdir Social Security Institution and livestock farmers is remarkable at this point. Because, two of main goals of ELBCP are focused on husbandry sector and employment, which is based on the economics of ecosystems and –naturally- ESs of the basin ("Eğirdir Lake Basin Conservation Plan", 2017.)

At last but not the least, negative opinions for the BCP were expressed by Eğirdir Municipality. The municipality, which is engaged in a lawsuit due to the interventions, has complained about spatial decisions and agricultural protected areas. Mayor of Eğirdir, Mr. Ömer Şengöl, who is chosen from an opposite party DP, mentioned, "After Eğirdir Lake Basin Conservation Plan, stores on the buildings and construction of roadways were banned. We cannot build any road or buildings, but except our municipality's border, new constructions can be seen" (2017). Certainly, to examine ER and ecosystem services on the basin, these interviews are insufficient. It can be

advantageous to analyze, understand, and discuss it with a SWOT Analysis by using data, academic research, and interviews about the BCP.

3.6 Summary of the Chapter

Turkey constitutes of 25 major basins. Eğirdir Lake Basin (3.309 km²), which includes the second biggest fresh-water lake, where has also an important drinking and irrigation water source, is an important part of Antalya Basin.

Eğirdir Basin (35° 37'-38° 16' N, 030° 44'-030° 57' E) is covered by steppe, scrub, and agricultural lands. It includes 81 settlements with Eğirdir, Senirkent, Yalvaç and Gelendost districts; and 77 different towns.

The basin has a powerful impact on the area economy, which is respectively based on fisheries, agriculture, industry, and tourism sectors. These economic activities are directly and indirectly linked with the basin's biodiversity, which is now under pressures in terms of their ER.

Under favor of the studies and projects that proceeded at the basin, ER measures such as water quality change, or vegetation change can be observable. In accordance with the practice of ER concept, ecological interventions have been put into action at the basin. 'Special Provisions' and '7 Colored Life to 7 Colored Lake' projects are only interventions, which are implemented at the basin and have significant features in terms of ER of SES. In addition to that, 'ELBCP' is the final intervention that is superimposed with previous interventions. The reason to choose this intervention type as a tool for ER concept is that the plan is, first, there are rich data about the plan to measure the ER, and second, it is considered as one of the most comprehensive ecological interventions in Turkey ("Orman ve Su İşleri, 2013).

4. THE ASSESSMENT OF ELBCP THROUGH THE METHODOLOGY DEVELOPED FOR ER OF SES

The strong link between society and basin ecosystems is a key element in applied ecological interventions and therefore should be integrated in PE and ER concepts, especially in developing countries like Turkey. As mentioned in the 2nd chapter, intervention projects that involve socio-ecological perspective requires an inter-disciplinary and inter-institutional policies. Thus, the case of ELBCP might be sustainably managed and made ecologically resilient by these policies and spatial decisions in accordance with SES.

The methodologies figured at the 1st chapter will be an illuminative and explanatory way to understand the ER of SES in Eğirdir Basin and the change of its states within the reference of ELBCP. These methodologies and their examinations on ELBCP will be given below.

4.1 The Assessment of ELBCP through the Literature Review

According to the definition of Hobbs et al. (1996), in theory, ELBCP can be counted as a regional level ecological intervention project. It involves not only halting the devastation of the ecosystem in Eğirdir Basin, but also efforts on political, spatial and economic decisions, which are also based on ESs such as fishery, freshwater, etc. Moreover, the plan has been superimposed with 'Special Provisions' and 'Seven Colored Life To Seven Colored Lake' projects, which are previous interventions of Eğirdir Basin. Hence, ELBCP can be an advantageous instrument to understand the impacts on the components of ER and SES.

On the other hand, according to the examination of ESs in Eğirdir Basin, it can be said that the basin has essential ESs for inhabitants in accordance with SES. ELBCP has theoretically focused on the restoration of those services. According to James M. Acheson, as mentioned before, the relationship between ESs and ER can be observable

with the natural equilibrium of the number of aquacultures such as lobsters (2013), which are represented same as crayfish in Eğirdir Basin. Accordingly, provisioning ESs like crayfish in Eğirdir Basin are undoubtedly representatives of outputs for agricultural economics. Therefore, this relationship might indicate the link into SES (Berkes et al. 2000).

Consequentially, either the limited number of studies at global on interdisciplinary framework or the deficiency of the number dissertations in Turkey about ER in SES hinder the improvement of the assessment of ELBCP as a tool to measure the ER in SES at basin level. As a result, it can be difficult to decide whether the plan achieves its goals -in accordance with literature assessment on ER in SES- or not, but it can be examined by discussing variable methods such as EWoRS, field interview and SWOT analysis of the ELBCP.

4.2 EWoRS Methodology and the Interpretation of the ELBCP in Terms of ER

Ecological regime shifts can be announced in advance by statistical early warning signals such as rising variance and slowing return rates from perturbation as stated in 1st chapter by Carpenter, et al (2011). The background for the theoretical framework of these indicators is abundant, but practical measures are rare, especially for basin-scaled ecosystems. For this conclusion part of the thesis, the hypothesis that these statistics would be early-warning signals, which will be tested with an experimentally induced regime shift components at Eğirdir Basin with by using in-year statistics for water quality assessment, phytoplankton biomass (Table 4.1), and crayfish procurement (Table 4.2). Therefore, these data were charted and compared with same type of data of Paul Lake (the lake was determined as non-manipulated and non-changed according to Carpenter, et al (2011). Further, the enactment date of ELBCP was marked on the graph and the EWoRS will be assessed before and after the BCP.

These parameters and charts can contribute to assess the affirmation or negotiation on the achievement of ELBCP's application or management in terms of ER. According to university libraries, Web of Science and other digital databases, the data of water quality assessment can be found only for the year 1990-2013. Moreover, the parameters on caught crayfish seems that they collected irregularly and unreliable. However, although this situation obstructs the EWoRS method, field research and two

years (2012 and 2013) data after the implementation of the BCP will play complementary role in the assessment framework of SES in Eğirdir.

Table 4.1 : Water quality and phytoplankton biomass parameters for Eğirdir Lake from 2010 to 2013.

	2010			2011			2012		2013		
	I	II	III	I	II	III	I	II	I	II	III
Phytoplankton Biomass	1,75	3,5	2,50	2,25	2,10	4,1	0,9	0,72	3,75	3	1,5
pH	7,34	8,6	9,32	9,2	9,5	9,2	9	9,3	6,8	8,7	7,5
DO (mg/L)	7,45	8,98	10,8	8	8,5	15,8	14,8	10,3	13,3	9,6	9,05

Table 4.2 : Crayfish procure parameters for Eğirdir Lake from 2010 to 2016.

	2010	2011	2012	2013	2014	2015	2016
Crayfish Procure (per trap)	28348	7032	30618	65752	63585	34997	109038

First, when the crayfish procure in Eğirdir Basin and Bass population in reference lake (Paul Lake) are compared, it can be said that, the change of bass population in Paul Lake indicates the state of ER shows balanced alteration in terms of regime shifts. However, the annual change of crayfish procure data in Eğirdir Lake can be considered as unbalanced alteration in accordance with EWoRS Methodology. In Eğirdir Lake, the alterations between years constitute high level of numbers.

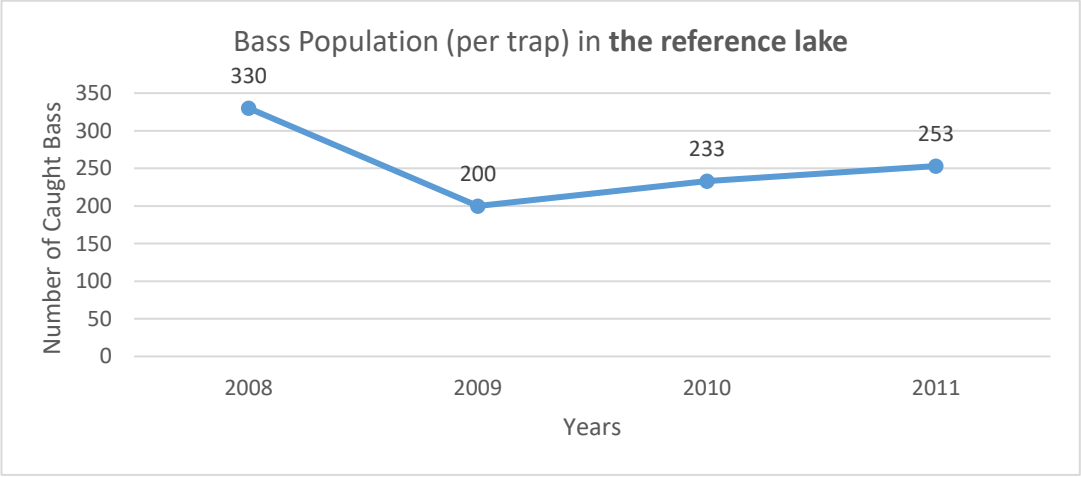


Figure 4.1 : Annual change of taken bass in Paul Lake.

In parallel with unbalanced changes and untrusted data, ELBCP did not ecologically contribute to the states of ER in the Lake, because after the enact of ELBCP, it is next to impossible that the caught crayfish cannot be doubled in one-year (figure 4.1).

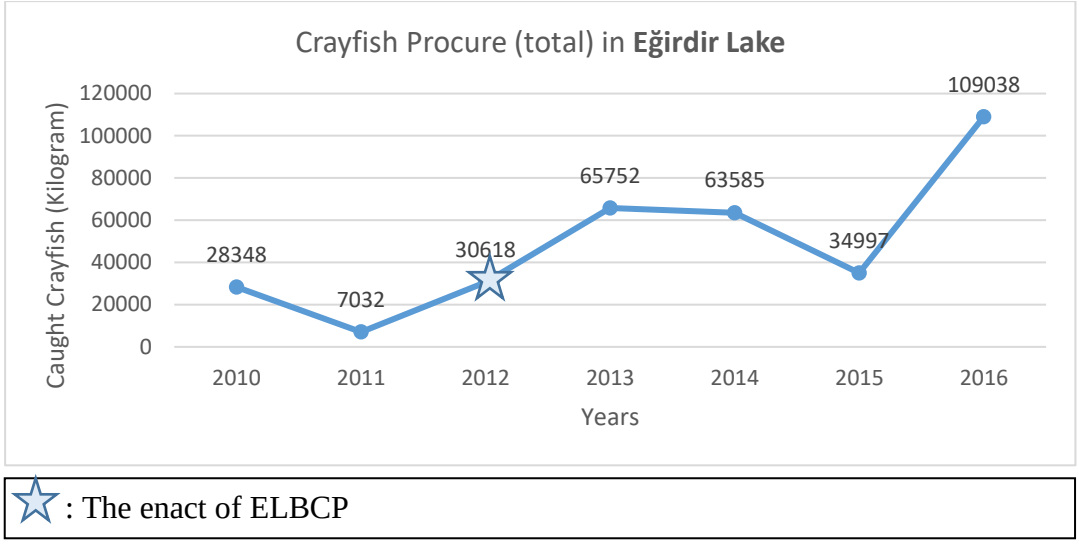


Figure 4.2 : Annual change of taken crayfish in Eğirdir Lake.

Second, the phytoplankton biomass can be assessed in terms of regime shifts in ER by comparing the reference lake and Eğirdir Lake in between the monitored years. According to Carpenter et al.'s study (2011), the change of phytoplankton biomass in Paul Lake can be read as balanced. It indicates that Paul Lake has a durable state of ER (Carpenter, et al., 2011), but when the same data for Eğirdir Lake is analyzed, it is clear that the changes show unhealthy levels in the states of ER (Figure 4.2).

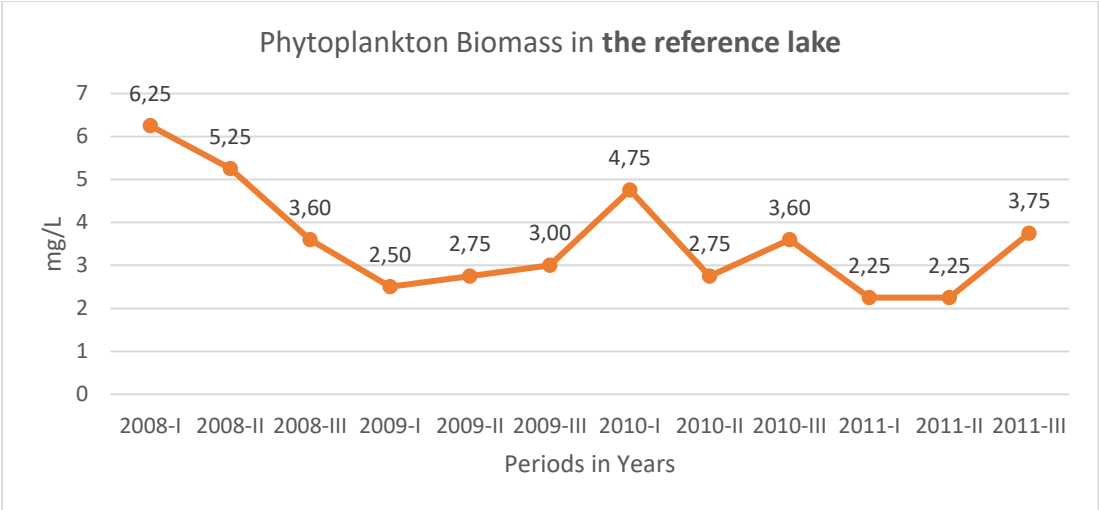
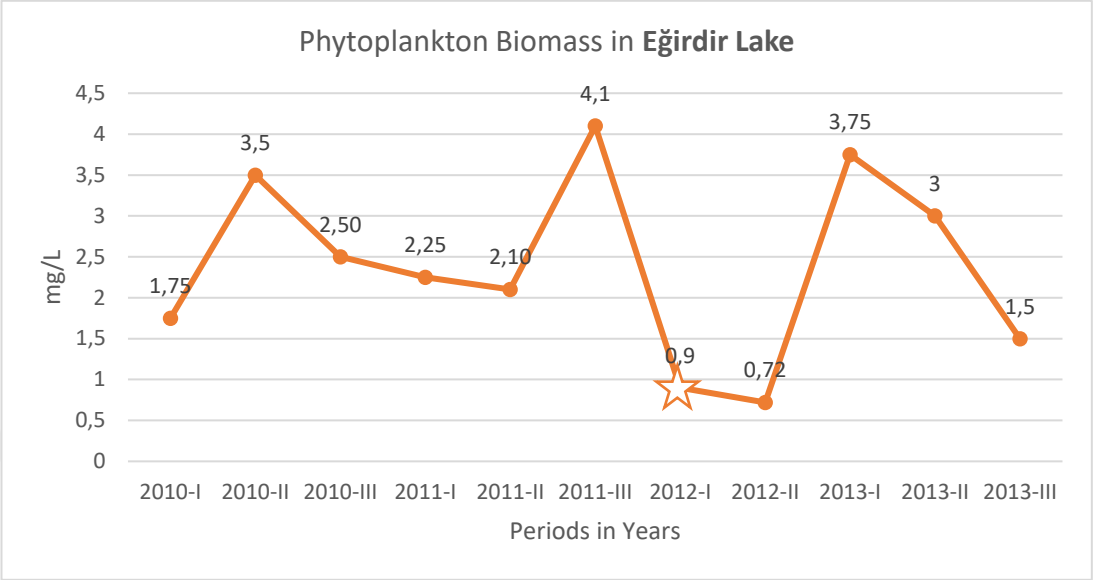


Figure 4.3 : Phytoplankton biomass change in Paul Lake (mg/L)

Last, the water quality assessment can be another instrument to measure the regime shifts in ER. To exemplify the balance in state changes at basin scale, pH and DO (Dissolved Oxygen) are key parameters, which are used by researchers studying with EWoRS method. In accordance with the EWoRS study for the reference lake, pH and

DO values do not have visible and crucial alterations between periods, but again in Eğirdir Lake, the changes cannot be observed as healthy and trustworthy. For instance, after the last period of 2012, pH and DO showed a sharp decline.



☆: The enact of ELBCP

Figure 4.4 : Phytoplankton biomass change in Paul Lake (mg/L).

Theoretically, such decline may be the results of critical negative impacts on the lake ecosystem. Regrettably, these data can cause unhealthy assessment about the regime shifts in Eğirdir Lake ecosystem.

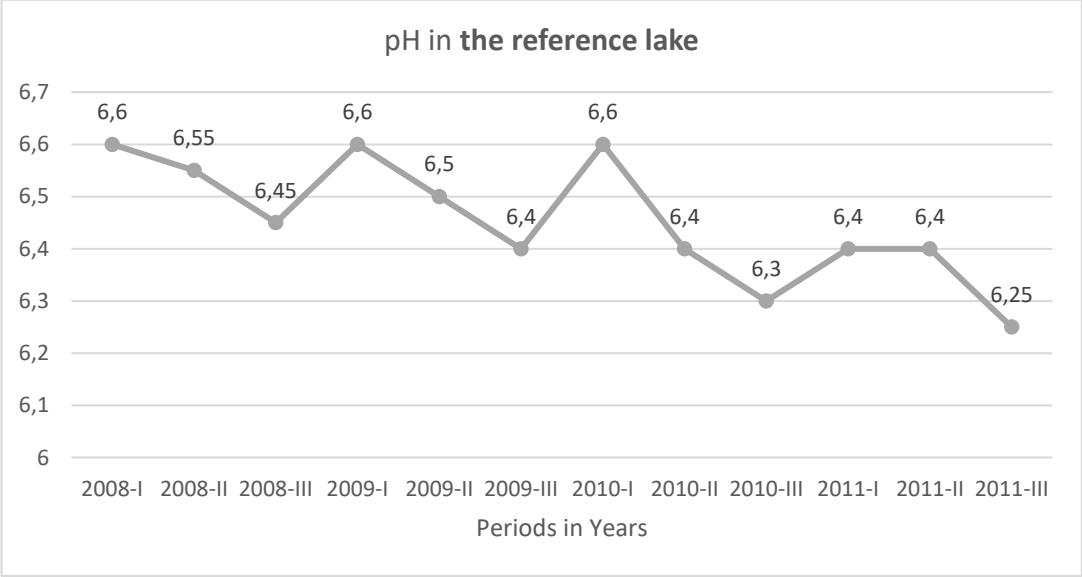
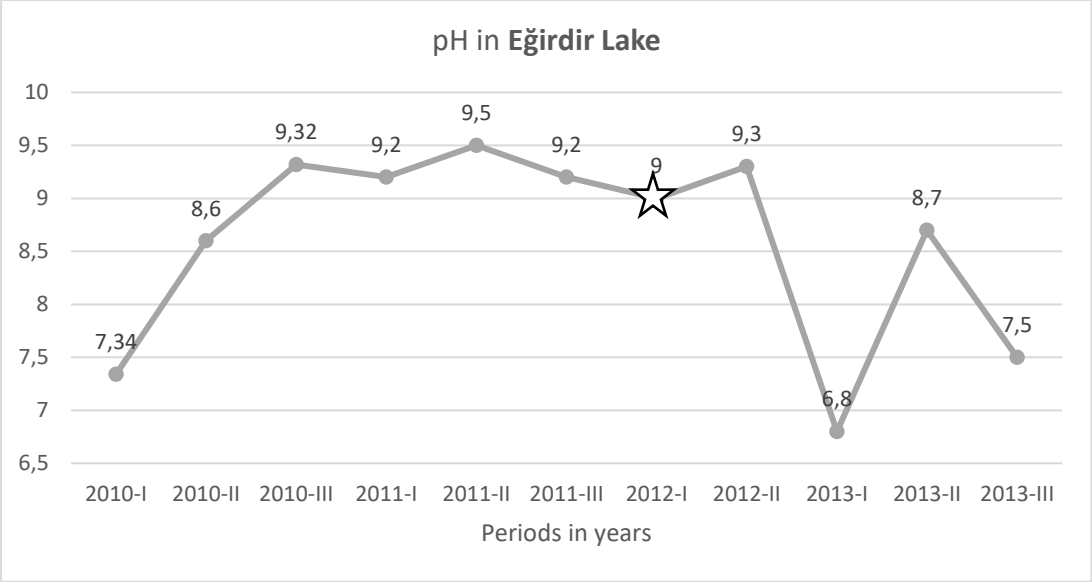


Figure 4.5 : pH change in Paul Lake.



☆ : The enact of ELBCP

Figure 4.6 : pH change in Eğirdir Lake.

As can be seen at the alteration graphs, although, EWoRS methodology is generally applied with by mathematical models and complicated statistical graphics, the simple framework of it can be relied on graphical data on catchment of fish and water quality parameters (figure 4.8).

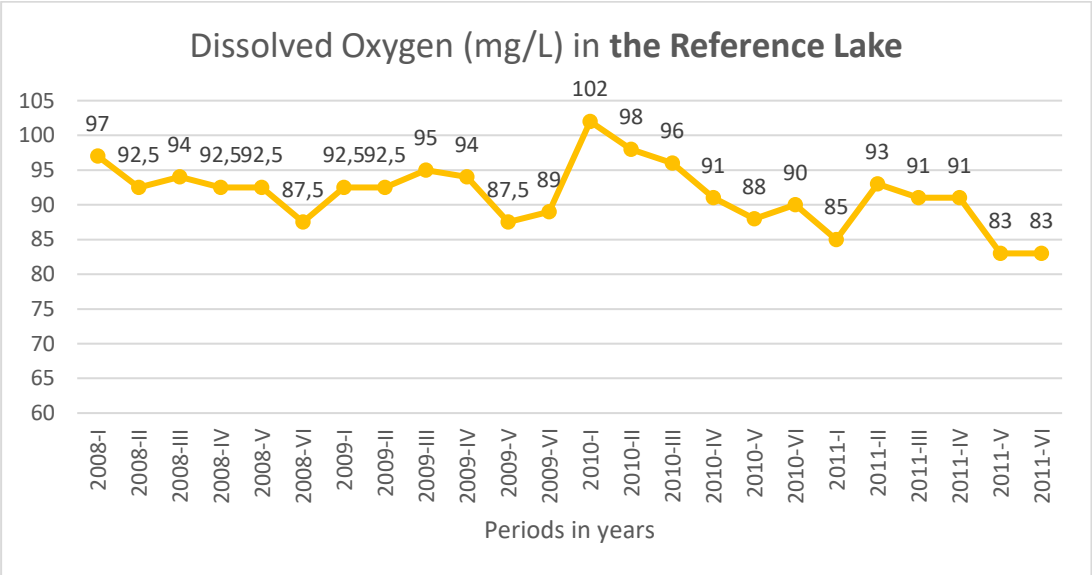
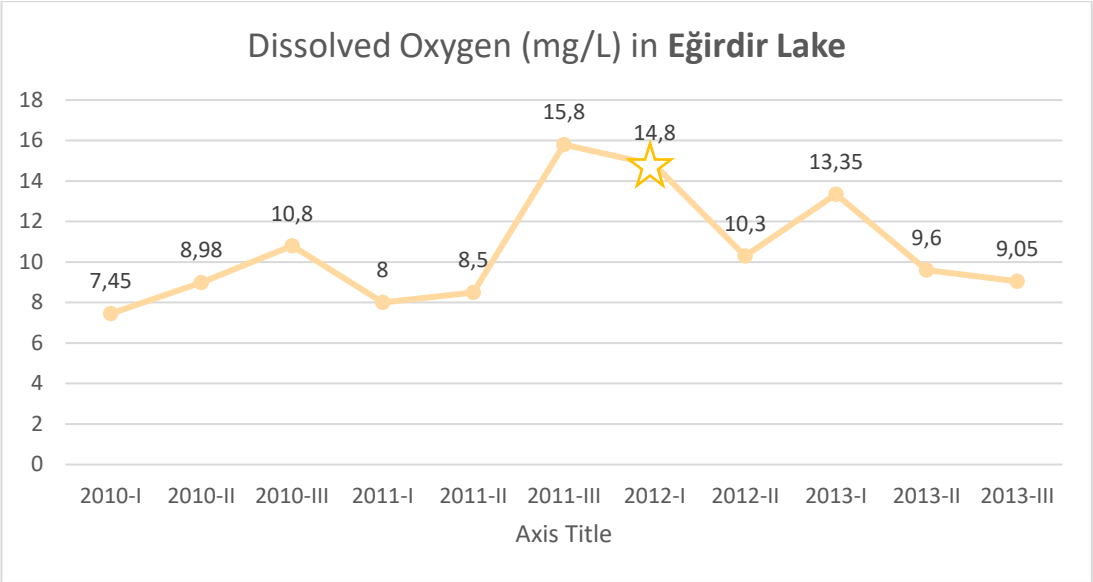


Figure 4.7 : The change of DO (mg/L) in Paul Lake.



☆: The enact of ELBCP

Figure 4.8 : The change of DO (mg/L) in Paul Lake.

As can be seen at the parameters of 'the change of DO,' 'pH change,' 'phytoplankton biomass change,' and 'annual change of taken crayfish (kg or per trap),' ELBCP has not significantly influenced the resilience of the regional ecosystem.

4.3 Field Survey, Interviews and the Interpretation of the ELBCP in Terms of ER in SES

The link between human and ecosystems can be examined with by official/unofficial institutions and persons in the scope of SES. As cited at the methodology section of this research, field survey and interviews with local people, institutions, cooperatives and universities can be an adventegous instrument to understand the awareness and consicousness of the ESs and their effects on the complex dynamics of resilence in SES.

This methodology was adapted to measure the awareness of resilience on ESs in Africa National Parks by Strauch et al. Starting from this, same methodology enlightened the dynamics of resilience on ESs and the evaluation of ELBCP, which was started in 2012 to be implemented.

The detailed information about the field survey and interviews were given at 1st chapter, but generally the method aims to:

- Understand the past situation of ESs, their effects on other dynamics of biodiversity, and their managements in Eğirdir Basin.
- To survey water resource quality using data collection methods.
- To spatially analyze the social and governmental institutions/persons affecting ecosystem services for improving the equilibrium and ER of SES.
- To determine the effects of ELBCP and current situation of SES.

Table 4.3 : The overview of field survey and interviews in terms of awareness on ELBCP.

Institution/Sector/Person(s)	Outputs	Explanation
Aquaculture Cooperative of Eğirdir	-	*"After the laws, ELBCP put us in a difficult position because we must pay more to hunt and take a boat out."*
Orchardists at Eğirdir Basin	+	*"May god be pleased with government! Everything is alright for us."*
Directorate of Eğirdir Social Security Institutions	0	*"It can't be said that, there is no any change on local employment after ELBCP."*
Cereal and Legume Farmers	0	All of farmers are uninformed about ELBCP project and its effects.
Animal Breeders	0	All of breeders are uninformed about ELBCP project and its effects.
District Directorate of Food, Agriculture and Livestock	+	For Aquaculture Station (SAREM): The lake recovered itself after ELBCP. For the district directorate, the quality and exportation of the aquaculture have an increment after the project.
Eğirdir Municipality	-	*"They canceled our spatial decisions and road constructions after ELBCP and they don't give any permission about our decisions."*
Süleyman Demirel University	0	They approach the positive outputs of the project suspiciously or they do not have sufficient data to analyze it.
District Presidency of AKP in Eğirdir	+	*"We hinder the repressive mindset and reconcile the people with conservation-usage equilibrium."*

To understand these subjects, instead of a fully documented interview outputs, a table demonstrating positive, negative, and neutral outputs according to interviewers will be more explanatory for the outputs of this methodology (Table 4.3).

As expected, none of the outputs for this methodology can interpret the complex dynamics of SES and results of ELBCP in terms of ER completely. However, taking into consideration that the opinions and awareness on ELBCP and its effects in the scope of ER can be considered as a tool to assess the efficiency of the project. On the other hand, EWoRS Methodology –as a theoretical way of ER- and SWOT Analysis –as a practical way of ER in SES- are supplementary instruments to conclude this research.

4.4 SWOT Analysis and the Interpretation of the ELBCP in Terms of ER in SES

According to SWOT analysis for the BCP, strengths and opportunities of the plan have strong influence to understand whether the plan has focused on restoring the ER of SES or not.

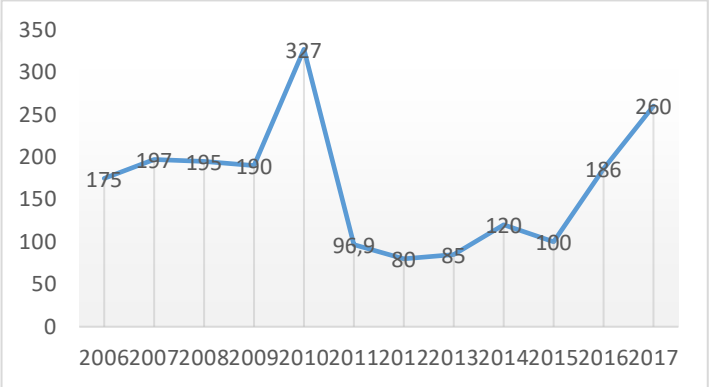


Figure 4.9 : Annual crayfish harvest from Eğirdir Lake (TÜİK, 2018).

Taking into account, from the framework of the PE, ELBCP is a comprehensive plan, because it has been supported by NGOs, cooperatives, and variable governmental or local authorities and it was superimposed with two other interventions. According to the field study, even if Eğirdir Municipality has not look optimistically to the project due to the prohibitions of spatial decisions, all government authorities, support the sustainability and applicability of the project. On the other hand, from the SES perspective, theoretically, the plan has attached particular importance to protection-utilization balance according to basin plan decisions.

Differently from strengths and opportunities, the measurement of the plan in terms of restoration of the ER can be examined at weaknesses and threats because all indicators, which are described by researchers, occur in weaknesses and threats column. When the Figure 4.9 is examined, it can be said that taken crayfish has not showed balanced alteration after the intervention started to apply. The unequable quantity of taken aquaculture in fresh-waters indicates the low-quality and non-stable state (Post, et al., 2002). Additionally, according to the interview with fishery cooperation of Eğirdir within the field research, the sudden decline of taken crayfish in 2010 was caused by district directorate of agriculture's enforcements in that year (Fishery cooperation of Eğirdir, 2017). This situation and the interference in 1950's (release invasive species to Eğirdir Lake to reinvigorate the local economy) cause the untrusting data on ESs in Eğirdir Basin in accordance with the ER of SES.

When table 4.2 is examined, neither positive nor negative alteration can be observable. It is clear that this situation has contravened to Yangfan Li's indications (2013). Moreover, from the social perspective of the BCP, it can be observable that many inhabitants in Eğirdir Basin are unaware of the plan. If ELBCP is comprehensive -as special provisions mentioned- (2013), it is necessary to be known by every individual from Eğirdir Basin.

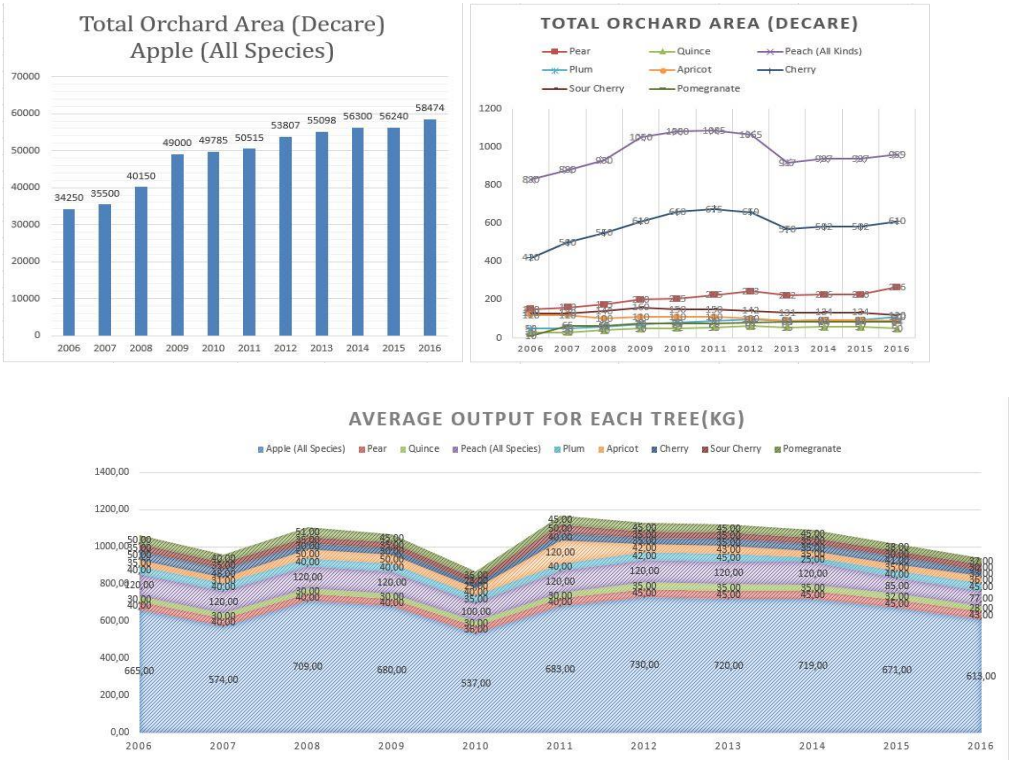


Figure 4.10 : Total orchard areas and average output for each fruit tree (TÜİK, 2017)

Table 4.4 : SWOT analysis of ELBCP in accordance with ER in SES at Eğirdir Basin

STRENGTHS	WEAKNESSES
▪ ELBCP is a comprehensive plan in terms of associating NGOs, and government authorities. This indicates that ELBCP can be considered as a strong PE tool ▪ The plan was mainly prepared by multiple bodies of government. The governorship, the district governorship, relevant ministries have consensus on the plan (T.C. Orman ve Su İşleri Bakanlığı, 2013). ▪ The plan has formed a basis for possible protection-utilization balance of Eğirdir Basin's ecosystem. ▪ The plan involves the protection of biotic, abiotic, and cultural factors in the basin (T.C. Orman ve Su İşleri Bakanlığı, 2013). Theoretically, this is an advantage in terms of ER of the basin.	▪ Some local authorities like Eğirdir Municipality confront of spatial decisions such as prohibition of roadway construction or story limit of buildings (Şengöl, 2017). ▪ Taken crayfish in Eğirdir has not shown any balanced alteration directly based on the conservation plan or there are insufficient data on aquaculture (Figure 4.1) (TÜİK, 2017). ▪ Average output, number of trees per square meter, and total orchard area for fruit trees has not shown any alteration directly –in terms of SES- based on the conservation plan (Figure 4.2) (TÜİK, 2017). ▪ According to EWoRS methodology (2013), water quality values can indicate the alteration of states of ER. ELBCP has not caused noticeable changes (Table 4.2)
OPPORTUNUTIES	**THREATS**
▪ To accomplish the plan, there are many responsible institutions and organizations were identified ("ELBCP", 2017.) ▪ Inhabitants, institutions, and organizations -except Eğirdir Municipality- look positively to the plan. ▪ The plan involves 81 different settlements within Eğirdir Basin (T.C. Orman ve Su İşleri Bakanlığı, 2013). ▪ Aquaculture Observation Station of Eğirdir has held with the plan (Apaydın Yağcı, 2017). ▪ During the field study, infrastructure set-ups for domestic and industrial wastewaters are observed.	▪ Fishery Cooperatives have difficulties to keep pace with the prohibitions about hunting and fishing boats (Eğirdir Cooperative of Fishery, 2017). ▪ Although Eğirdir Directorate of District Food Agriculture and Livestock claimed that "chemical wastes are cleaning anymore," during the field trip, there were empty chemical boxes and tanks, which can be a threat against the SES in Eğirdir Basin, were observed. ▪ According to site analysis, many inhabitants from districts within Eğirdir Basin are unaware of the plan.

5. CONCLUSION AND RECOMMENDATIONS

Overall, the development of effective, scalable restoration tools and approaches will inevitably be complicated by its broad multidisciplinary nature. Therefore, whatever the future direction, if ecological intervention is to result in reliable applied science, then strong collaboration will be required among ecological, economic, and social experts, as well as with private and public stakeholders, to encompass a diverse array of fields into a transdisciplinary co-designed approach.

In the light of the challenges, it seems that in order to make restoration efforts globally successful, at least the following issues have to be considered as Halme et al. mentioned:

"(1) Integrating ecological knowledge and restoration targets into fully working implementation plans requires increased cooperation between researchers and planners; (2) Planning across administrative and ownership borders needs to be implemented, to achieve targets of improved connectivity and more natural disturbance dynamics at the landscape level; (3) Long-term funding for monitoring should be protected, so that ecological effectiveness can be secured and constantly evaluated, and (4) Societal problems in the use and restoration of ecosystems should be addressed by integrating all stakeholders as a part of the planning process." (2012)

To conclude, according to SWOT analysis, field study, EWoRS methodology, and Halme's issues, BCP for Eğirdir Lake has failed to satisfy to be an ecological intervention project making the basin ecosystem more resilient. Even if not, ELBCP cannot restore the Longitude of the ER's state, it must be organized and managed to structurally and functionally restore the ecosystem to increase the extent and quality of ESs as Aronson et al. mentioned (2006) (Figure 5.1).

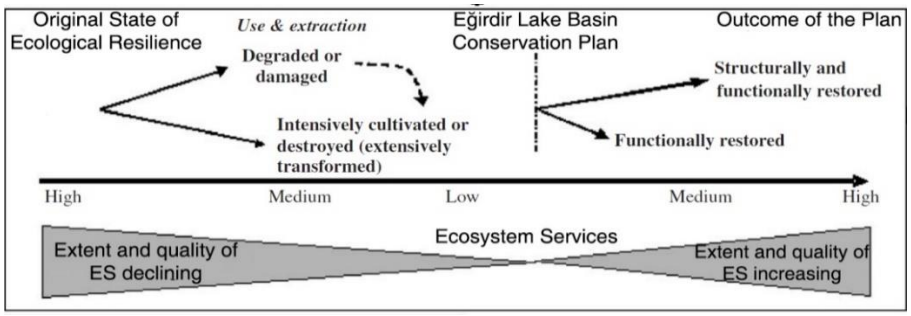


Figure 5.1 : Schematic description of the position of ELBCP within ER and extend and quality of ES change (adapted from Aronson, 2006).

It can be observable that, ecological interventions such as conservation, restoration, renewal, regeneration etc. can be considered as the much-discussed and most-implemented interaction to keep the balance between human and nature in terms of ER. Starting from this point of view and considering these inferences in the scope of ELBCP, it will be opportune to analyze the research questions as stated at the introduction. (1) Can ELBCP help to protect, sustain, and make the resilience of SES better? (2) Can we measure the change? (3) If the humans can heal the scars that made on Eğirdir Basin, how they can make this change more sustainable and manageable?

It is clear that, there are insufficient studies on how to measure ER in SES at basin level –especially in Turkey-. However, if interdisciplinary studies on this field are strengthened, methodologies such as EWoRS, field survey and SWOT are extended and supported; the sustainability and equilibrium of SES will be more resilient against the negative human impacts.

This thesis composed main concepts, which are related to the ER in SES, to analyze practical/theoretical studies on SES, to measure them with previous studies, to compare them with some interventions at basin scale and discuss with ELBCP. Accordingly, in the scope of the few numbers of studies and experiments on resilience of SES at basin scale, this research can be considered as one of the most illuminative study on the interdisciplinary field of ER concept and practice of SES.

Whether, ELBCP is applicable or sustainable for both ecosystems and social systems or not, the ecological intervention projects, with the key term of 'ER' and 'ESs', should include crucial aspects of the habitat and landscape. These can be classified as (1) eliminating interference factors and create a good habitat condition; (2) restoring ESs, create habitat and recover biodiversity to achieve more resilient ecosystem; and (3) constructing a sustainable socio-ecological structure within a sensitive ER.

Table 5.1 : General Attributes of ELBCP through ER in SES.

1. Project Name	Eğirdir Lake Basin Conservation Plan
2. Project Location	Eğirdir Basin, Isparta
3. Stakeholders	▪ Ministry of Environment and Urbanization ▪ Governorship of Isparta ▪ Siemens Household Appliances ▪ WWF Turkey ▪ Ministry of Forestry and Water Affairs ▪ General Directorate of Provincial Bank ▪ General Directorate of State Hydraulic Works ▪ Local NGOs ▪ General Directorate of Highways ▪ Provincial Directorate of Ministries
4. Tool of the Political Ecology	▪ Water Pollution Control Regulations ▪ Special Provisions ▪ "Seven Colored Life to Seven Colored Lake" ▪ Eğirdir Lake Basin Conservation Plan
5. Primary Objective(s)	▪ Clean and restore the damaged environment ▪ Improving the quality of Ecosystem Services ▪ Rehabilitation of manipulated Eğirdir Lake ▪ Implementation of Sustainable Agriculture Policies ▪ Increasing the local employment ▪ Conservation-Use Balance ▪ Implementation of Eco-Tourism Policies
6. Type of Implementation	▪ Ecological Restoration and Conservation
7. Methodology	▪ Enforcements ▪ Regulations
8. Land Characteristics of the Project	▪ Urban and Rural Settlements ▪ Irrigated Agricultural Area; ▪ Fresh-water Lake
9. Effects on Socio-Ecological Systems	▪ The plan theoretically contains 81 different settlements within Eğirdir Basin. ▪ Aquaculture Observation Station of Eğirdir supports the plan. ▪ It is a comprehensive plan in terms of associating NGOs, and government authorities. ▪ The governorship, district governorship, NGOs, and relevant ministries have consensus on the plan. ▪ The plan theoretically involves the protection of biotic, abiotic, and cultural factors in the basin.
10. Benefits and Effects on Ecological Resilience	▪ It is supportive for lake eco-system, because the enforcements against poaching have been useful in terms of the state of ER. ▪ Protection areas are implemented as ELBCP cited. ▪ "Agricultural protected sites" was declared on some agricultural lands. ▪ Sustainable Irrigation Systems were implemented.

Considering the theoretical framework –especially the assessment of the good practices- of the ER concept in SES, it might be constructive that ELBCP can be gathered with a compiler table as at 2nd chapter. As seen in table 5.1, the general attributes of ELBCP through ER in SES can be replaced with an explanatory conclusion part for the whole research of the case study.

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APPENDICES

APPENDIX A: Plan of Action of Eğirdir Lake Basin Conservation Plan

APPENDIX B: Water Quality Values for Eğirdir Basin

APPENDIX C: Trends in human use of ESs and enhancement or degradation of the services in MEA (2005)

APPENDIX D: Work Plan for ELBCP and their impacts on Eğirdir Basin's ER, "Eğirdir Lake Basin Conservation Plan (2013)

APPENDIX A

BASIN CONSERVATION WORK PLAN	2012	2013	2014	2015	2016	2017	2018	2019	2020	RESPONSIBLE INST. / ORG.
BASIN CONSERVATION ACTION PLAN										
COORDINATION OF INSTITUTIONS & ORGANIZATIONS										MFWA, MEU, Governorship
WASTE AND INFRASTRUCTURE MANAGEMENT										Municipalities, MFWA, MEU, PPA, Universities and Private Sector
Settlements Bigger Than 10.000 Population										
Running of Treatment Facility in Senirkent-Uluborlu Area										
Running of Treatment Facility in Gelendost-Bağıllı-Yaka										
Retooling of Treatment Facility in Yalvaç										
Monitoring and Auditing										
Settlements in Sanctuary Conservation Area										
Settlements, where population between 84-500										
Settlements, where population between 500-2.000										
Settlements, where population between2.000-10.000										
Monitoring and Auditing										
Settlements in Short Distance Conservation Area										
Settlements, where population between 84-500										
Settlements, where population between 500-2.000										
Settlements, where population between2.000-10.000										
Monitoring and Auditing										
PROJECT-ACTIVITY	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
Settlements in Middle Distance Conservation Area										Municipalities, MFWA, MEU, PPA, Universities
Settlements, where population < 84										
Settlements, where population between 84-500										

Settlements, where population between 500-2.000										
Settlements, where population between2.000-10.000										
Monitoring and Auditing										
Settlements in Long Distance Conservation Area										
Settlements, where population is < 84										
Settlements, where population between 84-500										
Settlements, where population between 500-2.000										
Settlements, where population between2.000-10.000										
Monitoring and Auditing										
Settlements in Long Distance - Basin Border										
Settlements, where population is < 84										
Settlements, where population between 84-500										
Settlements, where population between 500-2.000										
Settlements, where population between2.000-10.000										
Monitoring and Auditing										
Infrastructure and Treatment Facility For Industrial Waste Water										
Moving of Yalvaç Leather Industries to Yalvaç Organized Industrial Site and Running of Treatment Facility in Yalvaç Organized Industrial Site										MFWA, MEU, Stakeholders, Universities and Private Sector
Monitoring and Auditing										
PROJECT-ACTIVITY	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
In-Water Artifical Wetland Trench Systems										
Pupa Stream In-Water Artificial Wetland Trench System										
Yalvaç Stream In-Water Artificial Wetland Trench System										Municipalities, MFWA, MEU, PPA, Universities and Private Sector
Gelendost Drainage System In-Water Artificial Wetland Trench System										
Monitoring and Auditing										

MINING ACTIVITIES AND WASTE MANAGEMENT										MFWA, MEU, ETKB, Industrialists
Preparing Management Olan On Sectoral Basis and Applying										
SOLID AND HAZARDOUS WASTE MANAGEMENT										MFWA, MEU, Municipalities, WPU,EKLEPU, GYŞKMU
Solid Waste Treatment, Re-Cycle and Disposal Facilities										
Regular Dump Site - will be constructed in Yalvaç Sücüllü Area										
Preparing Bid Documents and Construction Projects										
Bid and Construction Works										
Monitoring and Auditing										
Running of Re-Cycle and Compost Facilities										
Generalize Pesticide Preparing and Collection Stations in Eğirdir Basin										
Rehabilitation of Yalvaç Dump Site and Treatment of Leachate										
Rehabilitation of Current Dump Sites										
PROJECT-ACTIVITY										
		2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
Rehabilitation of Current Dump Sites in Short Distance Conservation Area										MFWA, MEU, Municipalities, WPU, EKLEPU, GYŞKMU
Rehabilitation of Current Dump Sites in Middle Distance Conservation Area										
Rehabilitation of Current Dump Sites in Long Distance Conservation Area										
Rehabilitation of Current Dump Sites in Long Distance Conservation and Basin Area										
Preparing Bid Documents and Construction Projects										
Bid and Construction Works										
Monitoring and Auditing										
Land Improvement of Soil, wasted by Yalvaç Leather Industry										MFWA, MEU, Industrialists, Universities
Preparing Bid Documents and Construction Projects										

Monitoring and Auditing										
Hazardous and Special Waste Management										
Raise Awareness and Education										
Enforce Applicable Law										
Monitoring and Auditing										
Collecting and Disposing Pesticide Packages										EKLEPU, MFWA, MEU, Industrialists, Universities
Meet Cold Storage Depots to Standards in Basin Conservation Plan										
PROJECT-ACTIVITY	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
Management and Control of Non-point Source Pollution										PDEU, PDA, MEU, MFWA, EKLEPU
Agricultural Pollution Management										
Working on Inventory, Education and Raise Awareness										
Pressurized Water System Applications										
Working and Applications on Using Sludge in Agricultural Purpose										
Starting Organic Agriculture in Sanctuary Conservation Zone (Except Lake Green Belt and Geological Sanctuary Conservation Site)	In the Direction of Provincial Directorate of Agriculture									
Starting Good Agricultural Practices (Short and Middle Distance Conservation Areas)										
Generalize Good Agricultural Practices (Long Distance Conservation Areas)										
Starting the Application of Closed Irrigation System and Water Meter Systems in Eğirdir, Gelendost, Yalvaç, Senirkent Districts	In the Direction of General Directorate for State Hydraulic Works									MFWA
Husbandry Waste Management										PDEU, PDA, MEU, MFWA, EKLEPU
Working on Inventory, Education and Raise Awareness										
Developing Investment-Support-Encouragement Programs										
PROJECT-ACTIVITY		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	

Runoff Waste Management										
Constituting Lake Green Belt Area										GDH
Creating Stream Buffer Strip										
Creating Sediment Traps										
Monitoring and Auditing										
HIGHWAY WORKS										GDH
Completing Filtration Lanes in Highways										
Monitoring and Auditing										
FORESTATION, EROSION AND PASTURE IMPROVEMENT WORKS										MFWA
Investigation and Project Works										
Forestation and Erosion Control Works										
Forestation and Rehabilitation										
Erosion, Flood and Earth Landslip Works										
Pasture Improvement Works										
Rehabilitation of Stone Quarry and Mining Sites										Industrialists, MEU, MFWA
Planning and Implementation										
Monitoring and Auditing										
BUILDING EĞİRDİR LAKE INFORMATION SYSTEM										MFWA
Creating Infrastructure of the Information System										
Creating Database of the Information System										
Integration of Current Database to the Information System										
Set Boundaries of Built-up Areas										PPA

ABBREVIATIONS

MFWA - Ministry of Forestry and Water Affairs
MEU - Ministry of Environment and Urbanisation
GDPB - General Directorate of Provincial Bank
PWSA - Provincial Water and Sewerage Administrations
PDEU - Provincial Directorates for Environment and Urbanization
GDSHW - General Directorate of State Hydraulic Works
PPA - Provincial Private Administrations
GDSM - General Directorate of State Meteorology
WPU - Waste Producers Unity
PDA - Provincial Directorate of Agriculture
GDH - General Directorate of Highways
EKLEPU - Eğirdir and Kovada Lake Environment Protection Unity
GYŞKMU - Gelendost, Yalvaç, Şarkikaraağaç and Kasaba Municipality Union

APPENDIX B

Parameter	1953-54	1981-82	1986-87	1988-89	1990-91	1991-92	1996-98	1997-99	2006	2010-11	2012-13
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PH	8.9	6.5-7.8	8.4-8.7	8.3	7.2-9.7	-	7.6-7.75	8.4	8.7	8.60	7.54-8.05
Dissolved Oxygen (mg/l)	7.3-10.2	6.5-9.5	8-12.5	8.8	6.5-13.5	8.3	11.5	8.55	8.96	8.98	10.8
E.C.	-	-	-	284	270	245	460	343	381	~400	300
Cl (mg/l)	-	14.2-19.7	8.9-18.7	17.6	5-18	-	5-11	17	-	-	-
HCO3 (mg/l)	-	-	207	636-810	114-248	-	177-262	216.7	-	-	-
CO3 (mg/l)	-	-	24.8	-	4-18	-	10-40	19.7	-	-	-
SO4 (mg/l)	-	-	5.8-18.3	27.2	15-70	-	7.1-17.2	11.1		-	-
Ca (mg/l)	-	10.6-48	35.3	20-48	20-44	-	12-16	45	-	-	-
Mg (mg/l)	-	22-24	31.8	19-41	32-53	-	4.9-19.4	59.3	-	-	-
NO3 (mg/l)	-	-	<0.01	1.9	-	1.14	0.091	1.75	-	-	-
PO4-P (mg/l)	<0.001	-	<0.001	-	0-0.07	0.03	<0.001	0.05	0.13	0.08	-
Secchi Disc Visibility (m)	-	0.4-2.6	-	1.95	0.4-4.6	2	6.2	-	-		3.71-6.58
Chl.A	-	-	-	-	0-2.36	0.59	4.08	5.56	7.3	2.10	2.07

(1) Numann, 1958; (2) Merter, 1984; (3) Timur et al., 1988; (4) Bayrak et al., 1991); (5) Erk'akan et al., 1992; (6) Özkök, 1993; (7) Kazancı, 1999; (8) Aksoylar et al., 2001; (9) Gülle et al., 2006; (10) Beyhan, 2014; (11) Coşkun et al., 2015

APPENDIX C

Service	Sub-category	Human Use in SES (Increasing/ Decreasing)	Enhanced or Degraded in SES (Condition of ecosystems)	Notes
Provisioning Services				
Food	Crops	⬆	⬆	Food products are growing faster than population growth. Major source of the growing from increase in production per unit area, but also significant growing in cropland.
	Livestock	⬆	⬆	Primary reason of growth is intensive and confined production of chicken, pigs and cattle.
	Capture Fisheries	⬇	⬇	People usage of capture fisheries is declining due to the reduced supply, not reduced demand.
	Aquaculture	⬆	⬆	Usage of fish feed for carnivorous water species is placing an extra burden on capture fisheries.
	Wild plant and animal products	NA	⬇	Wild plant and animal sources decline because nature worldwide is under pressure.
Fiber	Timber	⬆	+/-	According to UNEP, earth has been lost 40% of forestland during the industrial era. Although these lands are recovering themselves in some temperate countries.
	Cotton, hemp, silk	+/-	+/-	These products have increased double and triple times in the last 40 years.
	Wood fuel	+/-	⬇	Overall consumption of wood fuel has peaked in

				the 1990s (MEA, 2005). Now, it is slowly declining except some regions.
Genetic Resources		⬆	⬇	These products are genetic information and genes to use for biotechnology, plant, and animal breeding.
Biochemicals, natural medicines, and pharmaceuticals		⬆	⬇	Lots of biocides, medicines, food additives, and biological materials are produced from eco-systems.
Ornamental resources		NA	NA	Shells, skins, and flowers are used as ornaments.
Regulating Services				
Air quality regulation		⬆	⬇	Ecosystems influence some aspects of air quality by contributing chemicals to the atmosphere and extract chemicals from it.
Climate regulation	Global	⬆	⬆	Land cover changes in history causes biophysical effect to cooling at global scale.
	Regional and local	⬆	⬇	Land cover changes affect local and regional climates positively and negatively.
Water regulation		⬆	+/-	This regulation type is related to flooding, runoff, and aquifer recharge.
Erosion regulation		⬆	⬇	Negative effects of crop/soil management and land use cause soil degradation and erosion.
Water purification and waste treatment		⬆	⬇	Water quality is declining globally. However, loss of wetland areas is

			decreasing the ability of eco-systems to decompose and filter waters.
Disease regulation	⬆	+/-	Major changes of infectious diseases in habitats both increase or decrease.
Pest regulation	⬆	⬇	Some pesticides are degrading the capacity of agro-systems. However, crops including pest resistant genes reduce the need for pesticides.
Pollination	⬆	⬇	Pollinators are declining in at least one country or region on all continents except Antarctica.
Natural hazard regulation	⬆	⬇	-
Cultural Services			
Cultural diversity	NA	NA	-
Spiritual and religious values	⬆	⬇	The numbers of sacred groves and other protected areas has been declining. However, the loss of some attributes can enhance spiritual appreciation under some circumstances.
Knowledge systems	NA	NA	-
Educational values	NA	NA	-
Inspiration	NA	NA	-
Aesthetic values	⬆	⬇	With increasing urban areas, pleasing natural landscapes has increased. There is also a decline in quality and quantity of lands to meet this demand.

Social relations	NA	NA	-
Sense of place	NA	NA	-
Cultural heritage values	NA	NA	-
Supporting Services			
Soil formation	♦	♦	-
Photosynthesis	♦	♦	-
Primary production	♦	♦	-
Nutrient cycle	♦	♦	-
Water cycle	♦	♦	People change water cycles as constructing structures in rivers, extraction of water from rivers and recently climate change.

⬆ ⬇ : Alteration of the usage of ESs in the scope of SES

+/- : The alteration that shows differences in the scope of SES

♦ : These services are not directly used by people.

APPENDIX D

BASIN CONSERVATION WORK PLAN	2012	2013	2014	2015	2016	2017	2018	2019	2020	RESPONSIBLE INST. and ORG.
WASTE AND INFRASTRUCTURE MANAGEMENT										
Settlements (bigger than 10.000 population)										
Running of Treatment Facility in Senirkent-Uluborlu Area	+	+	+	+	NA	NA	NA	NA	NA	Municipalities, MFWA, MEU, PPA, Universities and Private Sector
Running of Treatment Facility in Gelendost-Bağıllı-Yaka	+	+	+	+	NA	NA	NA	NA	NA	
Retooling of Treatment Facility in Yalvaç	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements in Sanctuary Conservation Area										
Settlements (84-500 population)	+	+	NA	NA	NA	NA	NA	NA	NA	
Settlements (500-2000 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements (2000-10000 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements in Short Distance Conservation Area										
Settlements (84-500 population)	+	+	NA	NA	NA	NA	NA	NA	NA	
Settlements (500-2000 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements (2000-10000 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements in Middle Distance Conservation Area										
Settlements (less than 84 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements (84-500 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements (500-2000 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements (2000-10000 population)	+	+	+	NA	NA	NA	NA	NA	NA	
Settlements in Long Distance Conservation Area										
Settlements (less than 84 population)	+	+	+	+	NA	NA	NA	NA	NA	Municipalities, MFWA, MEU, PPA, Universities
Settlements (84-500 population)	+	+	+	+	NA	NA	NA	NA	NA	
Settlements (500-2000 population)	+	+	+	+	NA	NA	NA	NA	NA	
Settlements (2000-10000 population)	+	+	+	+	NA	NA	NA	NA	NA	
Settlements in between Long Distance and Basin Border										
Settlements (less than 84 population)	+	+	+	+	NA	NA	NA	NA	NA	
Settlements (84-500 population)	+	+	+	+	NA	NA	NA	NA	NA	
Settlements (500-2000 population)	+	+	+	+	NA	NA	NA	NA	NA	
Settlements (2000-10000 population)	+	+	+	+	NA	NA	NA	NA	NA	

Treatment Facility and Infrastructure for Industrial Waste Water										
Moving of Yalvaç Leather Industries to Yalvaç Organized Industrial Site and Running of Treatment Facility in Yalvaç Organized Industrial Site	+	+	+	+	NA	NA	NA	NA	NA	MFWA, MEU, Stakeholders, Universities and Private Sector
In-Water Artificial Wetland Trench Systems										
Pupa Stream In-Water Artificial Wetland Trench System	+	+	+	+	NA	NA	NA	NA	NA	Municipalities, MFWA, MEU, PPA, Universities and Private Sector
Yalvaç Stream In-Water Artificial Wetland Trench System	+	+	+	+	NA	NA	NA	NA	NA	
Gelendost Stream In-Water Artificial Wetland Trench System	+	+	+	+	NA	NA	NA	NA	NA	
MINING ACTIVITIES AND WASTE MANAGEMENT										
Preparing and Applying Sectoral-Based Management Plan	0	0	0	0	0	NA	NA	NA	NA	MFWA, MEU, ETKB, Industrialists
SOLID AND HAZARDOUS WASTE MANAGEMENT										-
Solid Waste Treatment, Re-cycle Disposal Facilities										
Construction of Regular Dump Site in Yalvaç Sücüllü Area	0	0	0	+	+	+	+	+	+	
Running of Re-Cycle and Compost Facilities	0	+	+	NA	NA	NA	NA	NA	NA	
Extending Pesticide Preparing and Collection Stations in Eğirdir Basin	+	+	+	+	+	NA	NA	NA	NA	MFWA, MEU, Municipalities, WPU, EKLEPU, GYŞKMU
Rehabilitation of Yalvaç Dump Site and Treatment of Leachate	0	0	0	+	+	+	+	+	+	
Rehabilitation of Current Dump Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Rehabilitation of Current Dump Sites in Short Distance Conservation Area	+	+	+	NA	NA	NA	NA	NA	NA	
Rehabilitation of Current Dump Sites in Middle Distance Conservation Area	+	+	+	NA	NA	NA	NA	NA	NA	MFWA, MEU, Municipalities, WPU, EKLEPU, GYŞKMU
Rehabilitation of Current Dump Sites in Long Distance Conservation Area	+	+	+	NA	NA	NA	NA	NA	NA	

Rehabilitation of Current Dump Sites in Long Distance Conservation and Basin Area	+	+	+	NA	NA	NA	NA	NA	NA	
Land Improvement of Soil, wasted by Yalvaç Leather Industry	+	+	+	NA	NA	NA	NA	NA	NA	MFWA, MEU, Industrialists, Universities
Hazardous and Special Waste Management										
Raise Awareness and Education	+	+	+	+	+	+	+	+		MFWA, MEU, Industrialists, Universities
Enforce Applicable Law	+	+	+	+	+	+	+	+	+	
Collecting and Disposing Pesticide Packages	+	+	NA	NA	NA	NA	NA	NA	NA	EKLEPU, MFWA, MEU, Industrialists, Universities
Meet 'Cold Storage Depots' to Standards in Basin Conservation Plan	+	+	+	+	+	+	+	+	+	
MANAGEMENT AND CONTROL OF NON-POINT SOURCE POLLUTION										
Agricultural Pollution Management										
Preparing Inventory, Education and Raise Awareness	+	+	+	+	+	+	+	+	NA	
Pressurizing Water Systems	+	+	+	+	NA	NA	NA	NA	NA	
Using Sludge in Agricultural Purpose			+	+	+	+	+	+	+	
Starting Organic Agriculture in Sanctuary Conservation Zone (Except Lake Green Belt and Geological Sanctuary Conservation Site)	In the Direction of Provincial Directorate of Agriculture									PDEU, PDA, MEU, MFWA, EKLEPU
Starting Good Agricultural Practices (Short and Middle Distance Conservation Areas)	+	+	+	+	+	+	NA	NA	NA	
Extending Good Agricultural Practices (Long Distance Conservation Areas)	+	+	+	+	+	+	+	+	+	
Starting Closed Irrigation and Water Meter Systems in Eğirdir, Gelendost, Yalvaç, Senirkent Districts	In the Direction of Provincial Directorate of Agriculture									
Husbandry Waste Management										TKİB, TİM, ÇŞB, OSİB, EKO-BİR
Preparing Inventory, Education and Raise Awareness	+	+	+	+	+	+	+	+	NA	

Developing Investment-Support-Encouragement Programs	+	+	+	+	NA	NA	NA	NA	NA	
Runoff Waste Management										
Constituting Lake Green Belt Area	+	+	+	+	NA	NA	NA	NA	NA	PDEU, PDA, MEU, MFWA, EKLEPU
Creating Stream Buffer Strip	+	+	+	+	NA	NA	NA	NA	NA	
Creating Sediment Traps	+	+	+	+	+	+	NA	NA	NA	
HIGHWAY WORKS										
Completing Filtration Lanes in Highways	0	0	0	0	0	0	0	0	0	GDH
FORESTATION, EROSION AND PASTURE IMPROVEMENT WORKS										
Works on Investigation and Projects	+	+	+	NA	NA	NA	NA	NA	NA	
Forestation and Erosion Control Works										
Forestation and Rehabilitation	+	+	+	+	+	NA	NA	NA	NA	MFWA
Erosion, Flood and Earth Landslip Works	+	+	+	+	+	NA	NA	NA	NA	
Pasture Improvement	+	+	+	NA	NA	NA	NA	NA	NA	
Rehabilitation of Stone Quarry and Mining Sites	+	+	+	NA	NA	NA	NA	NA	NA	Industrialists, MEU, MFWA
CREATING EĞİRDİR LAKE INFORMATION SYSTEM										
Creating Infrastructure of the Information System	+	+	+	NA	NA	NA	NA	NA	NA	
Creating Database of the Information System		+	+	NA	NA	NA	NA	NA	NA	MFWA
Integration of Current Database to the Information System			+	+	NA	NA	NA	NA	NA	
SET BOUNDARIES OF BUILT-UP AREAS										
Set Boundaries of Built-Up Areas	0	0	0	0	0	0	0	0	0	PPA

ABBREVIATIONS

MFWA - Ministry of Forestry and Water Affairs
MEU - Ministry of Environment and Urbanization
GDPB - General Directorate of Provincial Bank
PWSA - Provincial Water and Sewerage Administrations
PDEU - Provincial Directorates for Environment and Urbanization
GDSHW - General Directorate of State Hydraulic Works
PPA - Provincial Private Administrations
GDSM - General Directorate of State Meteorology
WPU - Waste Producers Unity
PDA - Provincial Directorate of Agriculture
GDH - General Directorate of Highways
EKLEPU - Eğirdir and Kovada Lake Environment Protection Unity
GYŞKMU - Gelendost, Yalvaç, Şarkikaraağaç and Kasaba Municipality Union
+ : Indicates the actions that affect positively the ER of SES in Eğirdir Basin

CURRICULUM VITAE

Name Surname : **Eren Çağdaş BİLGİÇ**

Place and Date of Birth : **Altındağ – 21 July 1989**

E-Mail : **erenbilgic@gmail.com**

EDUCATION :

- **B.Sc.** : **Bilkent University, Department of Urban Design and Landscape Architecture**
- **M.Sc.** : -

PROFESSIONAL EXPERIENCE AND REWARDS:

- 2018 July – Current – Urban Design and Planning Consultant at AkademiA Inc.
- 2016 Sept. – Current – Instructor at Atılım University, Faculty of Architecture
- 2014-2016 – Co-Founder / Project Coordinator at Atölye DAS 'Design &Construction Works'
- 2013 - 2014 Urban Design Specialist at BNR Kentsel Dönüşüm ve Planlama

PUBLICATIONS, PRESENTATIONS AND PATENTS ON THE THESIS:

- **Bilgiç, E. Ç., Kavas, A.** 2018: Evaluating the 'Ghetto' Termt Through Turkey. AMPS: Constructing an Urban Future Conference. Abu Dhabi (2018) (Conference Proceeding)