

**ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF ARTS AND
SOCIAL SCIENCES**

**A CLOSE LOOK AT CITIZEN SCIENCE AS AN EXTENSION OF SCIENCE:
ACTOR NETWORK THEORY STUDY OF THE THREE LARGE SCALE
ENVIRONMENTAL CITIZEN SCIENCE PROJECTS IN TURKEY**

M.Sc. THESIS

Hilal US

**Department of Science, Technology and Society
Science, Technology and Society M.Sc. Programme**

JULY 2020

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ SOSYAL BİLİMLER ENSTİTÜSÜ

**BİLİMİN BİR UZANTISI OLARAK VATANDAŞ BİLİMİNE YAKINDAN BİR
BAKIŞ: TÜRKİYE'DEKİ ÜÇ BÜYÜK ÖLÇEKLİ ÇEVRESEL VATANDAŞ BİLİMİ
PROJESİNİN AKTÖR AĞ TEORİSİ ÇALIŞMASI**

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To my family and friends,



FOREWORD

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A CLOSE LOOK AT CITIZEN SCIENCE AS AN EXTENSION OF SCIENCE: ACTOR NETWORK THEORY STUDY OF THE THREE LARGE SCALE ENVIRONMENTAL CITIZEN SCIENCE PROJECTS IN TURKEY

SUMMARY

Citizen Science in other words Public Participation in Scientific Research has been flourishing in intersections of academia, civil society and policy making by becoming an extension of science and a subject of Science, Technology and Society Studies (STS). Citizen science literature has been developing with the considerations on research types, motivations, benefits and shortfalls of citizen science. This thesis carries an actor network theory approach and problematizes by considering the citizen science literature, how the three frequent type citizen science researches in Turkey which are ‘The Turkish Breeding Bird Atlas’, ‘The Map of Threats to Water Resources in Turkey’ and ‘The National Jellyfish and Gelatinous Organisms Watch Program’ have been constructed as an extension of science. In order to describe the research processes, qualitative multiple case study was conducted, thirteen semi-structured interviews were made with the project coordinators of the three projects and the active citizen scientists of the two projects. The interviews and the projects’ documents were analyzed with NVivo through using Michel Callon’s (1984) four moments of translation (problematization, interessment, enrolment, mobilization) and the themes of citizen science such as motivations, benefits, shortfalls and science. Each project was described in-detailed and the actor networks of the three projects were discussed with the citizen science literature. The actor networks of the three projects have indicated that the projects have been constructed by the associations of the human and the non-human actors with regard to environmental concerns. The shared research problem is to monitor environmental situation and to inform policy making. Institutional associations have appeared in the project networks considering the NGOs’ project conduct and the relations with the international institutions. The existing networks have affected volunteer and expert contributions to the projects. The citizen scientists have been assigned to send data by associating with the technologies which have mainly facilitated the research phases. The project coordinators have encountered with the low participation of the citizen scientists during the research. The project processes have been affected by the several sociotechnical associations demonstrating not linear research formations. The outcomes have been emerged by the associations of the project coordinators, the participated citizen scientists and the enabling technologies. The environmental situations of breeding birds, water resources and jellyfishes have been translated into the maps and shared in open access. The projects have been constructed as an extension of science accordingly by generating new knowledge with the contributions of the non-scientists through scientific methods including applying systematic design, benefitting from scientific references along with editing and analysis by the experts. The scientific outputs out of the projects have also related the projects with science. The projects have used science in the research phases and may contribute to scientific researches and evidence-based policy making. The common reason of using citizen science method has appeared as realizing nation-wide

monitoring by the volunteers' contributions; however, low participation of the volunteers has appeared as a shortfall of the three projects. The thesis contributes to the insights on citizen science in Turkey, research formation processes of citizen science, motivations of project coordinators and active citizen scientists, benefits and shortfalls of citizen science and science relation of citizen science with regard to large scale environmental citizen science research.

Keywords: *Citizen Science, Actor Network Theory, STS, Environment, Turkey*



BİLİMİN BİR UZANTISI OLARAK VATANDAŞ BİLİMİNE YAKINDAN BİR BAKIŞ: TÜRKİYE'DEKİ ÜÇ BÜYÜK ÖLÇEKLİ ÇEVRESEL VATANDAŞ BİLİMİ PROJESİNİN AKTÖR AĞ TEORİSİ ÇALIŞMASI

ÖZET

Vatandaş Bilimi bir diğer ifadeyle Halkın Bilimsel Araştırmaya Katılımı bilimin bir uzantısı ve Bilim, Teknoloji ve Toplum Çalışmalarının (BTTC) bir konusu haline gelerek akademi, sivil toplum ve politika yapımının kesişmelerinde gelişmeye devam etmektedir. Vatandaş bilimi literatürü araştırma türleri, motivasyonlar, fayda ve eksiklikler gibi hususlarda ilerlemektedir. Bir aktör ağı teorisi yaklaşımı taşıyan bu tez çalışması, 'Türkiye Üreyen Kuş Atlası', 'Türkiye Su Varlıklarına Yönelik Tehditler Haritası' ve 'Ulusal Denizanası ve Benzeri Türler İzleme Programı' örneklerinin oluşturduğu Türkiye'deki üç öne çıkan tip vatandaş bilimi araştırmasının bilimin bir uzantısı olarak nasıl inşa olduğunu vatandaş bilimi literatürünü de dikkate alarak sorunsallaştırmaktadır. Araştırma süreçlerini betimlemek için niteliksel çoklu durum çalışması yöntemi benimsenmiş, üç projenin proje koordinatörleri ve iki projenin aktif vatandaş bilimcileri ile on üç yarı yapılandırılmış görüşme yapılmıştır. İlgili görüşmeler ve projelerin dokümanları Michel Callon'un (1984) çevirinin dört anı (sorunsallaştırma, karışma, kayıt, seferberlik) ve motivasyonlar, yararlar, eksiklikler ve bilim gibi vatandaş bilimi temalarının kullanılması yoluyla NVivo ile analiz edilerek her bir proje detaylıca tanımlanmış ve projelerin aktör ağları vatandaş bilimi literatürü ile birlikte tartışılmıştır.

Türkiye Üreyen Kuş Atlası aktör ağlarının gösterdiği üzere, insan ve insan olmayan aktörlerin çevirinin dört anında ilişkilennemeleriyle Türkiye'de ulusal ölçekteki ilk üreyen kuş atlası bilimin bir uzantısı olarak inşa olmuştur. Üreyen kuşlar seçicilikleri ve kırılganlıklarıyla atlas çalışmalarında çevre indikatörü olarak tercih edilen aktörlerdir. Geçmişte kuş gözlemci sayısı ve finansal durum gibi kısıtlarla deneme aşamasında kalan Türkiye Üreyen Kuş Atlası, ana koordinatörün Avrupa Üreyen Kuş Atlası Kurulu ile iş birliği doğrultusunda İkinci Avrupa Üreyen Kuş Atlasının bir parçası haline gelerek 2014 yılında başlamış ve Türkiye'deki kurumsal ve topluluk ağı ilişkilennemeleriyle yürütülmüştür. Karışık profil fakat başlıca batıda ve büyükşehirlerde yaşayan ve yüksek eğitimlilerin daha çok kayıt girdiği özellikleriyle tanımlanan kuş gözlemcileri projenin diğer aktörleridir. Koordinatörler ve aktif vatandaş bilimciler projeye yönelik motivasyonlarını literatürle uyumlu bir şekilde kuşlara ilgi ve doğada bulunma gibi özerk motivasyonlar ile kuşları koruma, doğa koruma ve bilimsel araştırmaya katkı gibi özgecil motivasyonlarla ifade ederken, ana koordinatörü ve çalışmalarını tanıma koordinatör ve aktif vatandaş bilimcilerin katılımına dair vaka özelinde bir motivasyon olarak ortaya çıkmıştır. İnsan ve insan olmayan aktörlerin sorunsallaştırma anındaki ilgili ilişkilennemeleriyle araştırma problemi, Türkiye çapında üreyen kuşların durumunu koruma için bilimsel olarak izlemek ve bu doğrultuda kuş gözlemcilerinin atlas veri tabanına veri girerek katılması olarak inşa olmuştur.

Sorunsallaştırmayı aktörlerin yöntemdeki ilişkilenmelerine dair karışma anı izlemiştir. Proje koordinatörleri 2014-2017 yılları arasında kuş gözlemcilerinin Türkiye çapında belirlenen 166 adet 50x50 km'lik kareler içerisinde kuşları üreme dönemlerinde süreli ve serbest çalışma yöntemleriyle gözlemleyip, 16 adet üreme kodu içeren kayıt formunu doldurarak eKuşbank veri tabanına veri girmeleriyle veri toplamayı planlamıştır. İlgili süreçteki teknolojiler veri toplama ve veri analizine olanak sağlayan aktörlerdir. Coğrafi bilgi sistemlerinin harita oluşturmadaki fizibilitesi vurgulanmıştır. Konumlama destekli uygulamaların projeye erişimi arttırdığı belirtilirken, kâğıt tabanlı teknolojilerin de tercih edilebildiği ifade edilmiştir. Koordinatörler kuş gözlemcileriyle iletişim ve kuş gözlemcilerine geri bildirim için sosyal medyadan faydalanmıştır. Yöntem araştırma problemini gerçekleştirmek için aktörlerin belirlenen rollerine uyması beklenerek inşa olurken, kayıt anında kuş gözlemcilerinin düşük katılımı gerçekleşmiştir. Projenin kişisel çatışmalar, ülkedeki siyasi karışıklıklar ve gönüllülerin meşguliyetleri gibi birçok ilişkilenmelerden etkilendiği ifade edilmiştir. Aktif vatandaş bilimciler veri toplama süreçlerini etkileyen insanlarla etkileşim, süreli çalışmanın katı prosedürü ve güvenlik güçlerinden onay almadan bahsetmiştir. Proje koordinatörlerinin bölgesel toplantılarla katılımı artırma, metodolojinin daha uygulanabilir hale getirilmesi ve 2000 yılından itibaren eski kayıtların atlasa dahil edilmesi gibi stratejileri ile 2018-2019'da bilimsel komitenin veri analizi ve düzenlemesi doğrultusunda seferberliğe dair sonuç inşa olmuştur. Proje koordinatörleri araştırma sürecini ve haritalara çevrilen üreyen kuşların durumunu proje raporu ve proje web sitesiyle açık erişimle paylaşmıştır. Projenin bilimle ilişkisine dair betimleyici çalışma olması, bilimsel yöntemi, ileri çalışmalara referans olması ve bilimsel çıktıları vurgulanmıştır. Vatandaş bilimi yöntemini seçme nedeni büyük ölçekteki kitleden güncel ve devamlı veri sağlamak olarak belirtilmiştir. Proje sonrası vatandaş bilimi yönteminin yararları ve eksiklerine ilişkin, koordinatörler büyük bir kitleden büyük ölçekte veri toplama, mobil vatandaş bilimcilerin online veri tabanları ile her yerden güncel veri sağlaması ve masrafların bertaraf edilmesini yararlar, düşük katılım, gönüllü yönetimi ve düzeltme gerektiren kötü veri kalitesini eksikler olarak belirtmişlerdir. Aktif vatandaş bilimciler ise sistematik yöntemle büyük ölçekte veri üretme, gelişme aşamasındaki bürokrasi desteği ve topluluk farkındalığını yararlar, zayıf gönüllülük ve saha çalışması kısıtlanmasını ise eksikler olarak ifade etmişlerdir.

Türkiye Su Varlıklarına Yönelik Tehditler Haritası aktör ağlarında ise sorunsallaştırma anında su varlıkları nicelik, nitelik ve erişim tehditlerine karşı diğer aktörleri harekete geçirmiştir. Tema Vakfı yürütücülüğündeki ilgili proje, Avrupa birliği destekli Türkiye ve Batı Balkanlar'daki kanıta dayalı çevre politikası yapımını desteklemeye yönelik Env-Net ağının bir parçası olarak 2016 itibariyle başlamıştır. Daha önce benzer proje deneyimleri olan ana proje koordinatörünün vakıftaki iş birlikleri doğrultusunda araştırma problemi, ilk olarak Türkiye'deki su varlıklarına yönelik tehditlerin Tema gönüllü il temsilcilerinin araştırması yoluyla izlenmesi ve temsilcilerin su tehditlerini araştırarak öğrenmesi olarak inşa olmuştur. Vatandaş bilimcilerin profili ana koordinatör tarafından Tema'yı takip eden sınırlı sayıdaki çevreciler olarak tanımlanmıştır. Koordinatör ve aktif vatandaş bilimciler projeye dair literatürle tutarlı özerk, özgecil ve pragmatik motivasyonlar belirtirken, aktif vatandaş bilimcilerce belirtilen görev ve ilgili altyapı vaka özelinde bir motivasyondur. Karışma anında ana proje koordinatörü proje yönteminde su varlığına dair nicelik, nitelik ve erişim tehdit kategorileri, tehdit nedenleri, tehdide karşı hareketler, ilgili kurumlar ve referanslar gibi başlıklarla bir online bilgilendirme formu hazırlayarak il temsilcilerine kapalı bir sistemle göndermiş, her şehrin su varlıklarına yönelik tehditlerin ilgili tem-

silciler tarafından araştırılarak gönderilmesini beklemiştir. Aktif vatandaş bilimciler ilişkilendikleri teknolojilerin veri toplamayı hızlandırdığını ve büyük ölçekte erişim sağladığını belirtirken, ana koordinatör online harita geliştirmenin kolaylaştığını ve coğrafi bilgi sisteminde yaşanan gelişmeler doğrultusunda projeyi kapalı sistemden interaktif haritaya çevirdiğini belirtmiş, teknolojinin projeyi geleneksel sosyal bilim araştırmasından ayıran ana aktör olduğunu vurgulamıştır. Kısa bir sürede içerisinde beklenen gönüllü katkısına dair ilk sonuç, kayıt anında otuz bir temsilci tarafından otuz yedi şehirde elli dokuz tehdit belirlenmesiyle ortaya çıkmıştır. Koordinatörler projeyi vakfın yoğun gündemi ve Türkiye'nin siyasi durumunun etkilediğini belirtirken, aktif vatandaş bilimciler referans azlığı ve zayıf iletişimin etkisinden bahsetmiştir. Katılan gönüllülerin teknolojilerle ilişkilenerak sağladığı verilerin ana koordinatör tarafından düzenlenip analiz edilmesiyle seferberlikle devam eden sonuç inşa olmuştur. Proje koordinatörü Türkiye'deki su varlıklarına yönelik tehditlerin durumunu haritalara çevirerek harita ve proje raporu ile birlikte 22 Mart 2016 Dünya Su Günü'nde paylaşmıştır. Harita teknolojisindeki gelişmeler doğrultusunda proje koordinatörü projeyi mobil veri tabanına dönüştürerek halkın veri girişine açmıştır. Halk erişimiyle güncel olarak tehdit sayısının iki katına çıktığı platform veri girişine açık durumdadır. Projenin güncel koordinatörleri her sene dünya su gününde yayınlanan haritanın yeni bir projeye eklenerek canlandırılması planından bahsetmişlerdir. Proje insan ve insan olmayan aktörlerin çevirinin dört anında ilişkileneceği doğrultusunda bilimin bir uzantısı olarak inşa olmuştur. Koordinatörler ve aktif vatandaş bilimciler projenin bilimle ilişkisine dair raporla doğrudan veri ortaya çıkması, problemlerin çözümünde problemlerden başlıca etkilenenlerin sesini güçlendiren bir bilim anlayışı olması, projenin yöntemi ve bilimsel referansların kullanımı gibi ilişkileri belirtirken, projenin bilimsel çıktısı ve bilimsel araştırmalara katkı sağlayabileceği ifade edilmiştir. Projenin akademideki ilgili boşluğu doldurması ve ulusal ölçekte durumu ortaya koyması vurgulanmıştır. Vatandaş bilimi yöntemini seçme nedeni katılımcıların çevresindeki su tehditlerine dair çevresel farkındalığını arttırıp harekete geçmesini sağlamak ve Tema'nın savunuculuk çalışmaları için su tehditlerinin ulusal ölçekte ortaya çıkarılması olarak belirtilmiştir. Ana koordinatör proje deneyimi sonrası vatandaş bilimi yönteminin fayda ve eksikliğine dair yerel bilgiye ulaşılmasını yarar, düşük veri kalitesi ve düşük katılımı eksikler olarak belirtmiştir. Aktif vatandaş bilimciler ise bilimin tabana yayılması, bilimsel düşüncenin gelişmesi, çevresel farkındalık ve koruma bilincinin artması, projenin mobil özelliği gibi yararlar belirtirlerken, bilgi kirliliğinde yanılma riski, gönüllülerin kaçınması ve iletişim problemleri gibi eksiklikler ifade etmişlerdir.

Ulusal Deniz Anası ve Benzeri Türler İzleme Programı bir diğer ismiyle Ya Yakarsa aktör ağlarına göre, Türkiye sularında deniz suyu sıcaklıklarının artması, aşırı avlanma ve kirlilik gibi etkilerle deniz anaları çoğalmakta ve Kızıldeniz'den gelen yeni zararlı türlerin insan ve insan olmayanlarla ilişkilenecekleri ile sağlık problemleri, turizm sorunu ve ekonomik problemler yaşanmaktadır. İlgili sorunsallaştırma doğrultusunda Türk Deniz Araştırmaları Vakfı uzmanları 2014 yılında harekete geçmiş ve araştırma problemi, Türkiye sularındaki deniz anası dağılımı ve sıklığını ulusal ölçekte izlemek ve deniz anası artışı ile zararlı etkilerini bilimsel olarak ortaya koyarak fenomen üzerine politika yapımcıları yönlendirmek olarak inşa olmuştur. Ana koordinatör projeye dair motivasyonunu artan deniz analarına karşı deniz anası türlerinin tanınması olarak ifade etmiştir. Proje Akdeniz Bilim Komisyonu'nun Akdeniz kıyıları ve açık denizdeki deniz anası artışını izlediği JellyWatch programı ile uyumludur. Sorunsallaştırma üzerine karışma anında proje koordinatörleri yöntemi halkın deniz anasının adı, görüldüğü bölge, metrekaresine düşen sayı, gözlem tarihi,

gözlemci kişisel bilgileri ve gözlemin fotoğraf ya da videosu gibi başlıklar içeren online bilgi formunu kullanarak deniz anası gözlemlerini telefon ya da e-mail gibi araçlarla koordinatörlere iletmesi doğrultusunda veri toplanması ve uzman proje koordinatörlerinin veriyi insana, balıkçılığa ve biyolojik çeşitliliğe zarar durumu doğrultusunda analiz etmesi şeklinde inşa etmiştir. Koordinatörler ayrıca deniz anası türleri ve toksisite seviyelerine dair bir poster hazırlayıp dağıtarak veri toplanmasını kolaylaştırmayı amaçlamıştır. Ana koordinatör teknolojinin önemini vurgulayarak fotoğraf teknolojisindeki gelişmelerle türler arası ayrımın yapılabildiğini belirtmiştir. Kayıt anında vatandaş bilimcilerin düşük katılımı gerçekleşmiştir. Ana koordinatör proje sürecinde deniz anası türlerini tanımlamak için uzmanlığın öneminden bahsetmiştir. Katılan aktörlerin ilişkilenmeleri doğrultusunda seferberliğe dair ilk sonuç inşa olurken, Türkiye'deki deniz anası ve benzeri türlerin durumu haritaya çevrilerek proje web sitesiyle açık erişimle paylaşılmıştır. Proje araştırma problemini gerçekleştirmek için veri toplamaya güncellenerek devam etmektedir. İnsan ve insan olmayan aktörlerin çevirinin dört anında ilişkilenmeleri doğrultusunda proje bilimin bir uzantısı olarak inşa olmuştur. Ana koordinatör projenin bilimden faydalandığını, yeni bilgiler öğrenilmesi doğrultusunda bilime katkı sağladığını ve proje ile ilgili bilimsel çıktıyı belirtmiştir. Ana koordinatör vatandaş bilimi yöntemini seçme nedenini büyük ölçekte masrafsız şekilde veri toplamak olarak açıklarken, vatandaş bilimi yönteminin yarar ve eksikğine ilişkin, belirli bölgelerdeki belli insanların çabasını yarar olarak ifade ederken, düşük katılımı eksik olarak belirtmiştir.

Üç projenin aktör ağlarının gösterdiği üzere, projeler insan ve insan olmayan aktörlerin çevresel sorunlara karşı ilişkilenmeleri ile inşa olmuştur. Ortak araştırma problemi çevresel durumu izlemek ve politika yapımını bilgilendirmektir. Sivil toplum kuruluşlarının proje yürütmesi ve uluslararası kurumlarla bağlantılar göz önüne alındığında, proje ağlarında kurumsal ilişkilenmeler ortaya çıkmıştır. Var olan ağlar projelere gönüllü ve uzman katkılarını etkilemiştir. Vatandaş bilimciler çoğunlukla araştırma süreçlerini kolaylaştıran teknolojilerle ilişkilenerken veri göndermeleri için görevlendirilmiştir. Proje koordinatörleri araştırma sürecinde vatandaş bilimcilerin düşük katılımı ile karşılaşmıştır. Araştırma süreçleri doğrusal olmayan araştırma yapımını gösteren birçok sosyoteknik ilişkilenmelerden etkilenmiştir. Araştırma sonucu proje koordinatörleri, katılan vatandaş bilimciler ve olanak sağlayan teknolojilerin ilişkilenmeleriyle ortaya çıkmıştır. Üreyen kuşların, su varlıklarının ve denizanalarının çevresel durumu haritalara çevrilerek açık erişimle paylaşılmıştır. Projeler sistematik tasarım uygulama, bilimsel referanslardan faydalanma, uzmanlar tarafından düzenleme ve analiz gibi bilimsel yöntemler yoluyla bilim insanı olmayanların katkıları ile yeni bilgi üretilmesi doğrultusunda bilimin bir uzantısı olarak inşa olmuştur. Projelerin bilimsel çıktıları da projeleri bilimle ilişkilendirmiştir. Projeler araştırma aşamalarında bilimi kullanmıştır ve bilimsel araştırmalar ile kanıta dayalı politika yapımına katkı sağlayabilir. Vatandaş bilimi yöntemini gerçekleştirmenin ortak nedeni gönüllülerin katkılarıyla ulusal çapta izleme gerçekleştirmek olarak ortaya çıkmıştır; fakat, gönüllülerin düşük katılımı üç projenin de eksikliği olarak belirlemektedir. Tez büyük ölçekli çevresel vatandaş bilimi araştırmalarına ilişkin, Türkiye'deki vatandaş bilimi, vatandaş biliminin araştırma oluşum süreçleri, proje koordinatörleri ve aktif vatandaş bilimcilerin motivasyonları, vatandaş biliminin faydaları ve eksiklikleri ile vatandaş biliminin bilim ilişkisine dair çıkarımlara katkıda bulunmaktadır.

Anahtar Kelimeler: *Vatandaş Bilimi, Aktör Ağ Teorisi, BTTÇ, Çevre, Türkiye*

1.INTRODUCTION

Science is the sociotechnical assemblage as a way of understanding and changing the environment. A scientist indicates that earth has been strikingly getting warmer since 1950's due to increased greenhouse gases especially carbon dioxide as result of burning fossil fuels in energy production, transportation, land degradation ex cetera and if the earth passes almost 1.0° C temperature increase in present and exceeds 4.5° C increase in future, it is likely not going to host humans anymore (Farmer, 2015). United Nation's the Intergovernmental Panel on Climate Change utilizes from scientific research while declaring the urgent need to implement preventive actions on upcoming global 1.5° C increase which threatens environment for humans and non-humans (IPCC, 2018). In terms of public taking action, a public understanding of climate change and carbon capability survey indicates low active engagement for combatting climate change individually and collectively (Whitmarsh et al, 2011). Science is sociotechnical by constructing environmental facts, connecting to environmental policy making, developing technologies that either pollute or protect environment and assessing public attitudes towards environment.

Science, Technology and Society Studies (STS) consider sociotechnical science as its research subject. STS flourish in 1970's with Sociology of Scientific Knowledge (SSK) which evaluates science as a socially constructed discipline explaining and changing the world; whereas, Actor Network Theory (ANT) as another main STS theory differentiates from SSK with its constructivism redefining social by emphasizing relational interactions of human and non-humans without macro - micro divisions (Law, 2017). Considering the relation of science and environment, STS as a discipline asks how environmental facts have been constructed, how science is related with environmental politics, how environment has been affected by technoscience and how science is related with public in environmental issues.

Science includes various ways of understanding and changing the world through scientific disciplines. STS scholars are very much influenced by Thomas Kuhn's work *The Structure of Scientific Revolution* in which concept of paradigm explains such variety in science. According to the common understanding of the concept, paradigm refers to particular theoretical, conceptual and practical ways of doing science shared by scientists in a scientific discipline. There is a dynamic process consisting of challenged paradigms which may result with new paradigms (Rouse, 2002, pp.103-106). New paradigm of science has been argued which has been called Post-Normal Science (Funtowicz and Ravetz, 2020). Toward paradigm of post-normal science, contemporary science vision considering public as receivers of or respondents to scientific inquiry has been extended with public participation in scientific research in other words citizen science which has become an extension of science.

Citizen science as an extension of science promises contributions to science and society. Citizen science is defined as the socially and environmentally concerned scientific inquiry in which non-scientists participate to the scientific research by generating scientific knowledge (Strasser and Haklay, 2018, pp.32-33). The importance of citizen science for policy making is emphasized by stating that citizen science contributes to UN's Sustainable Development Goals (SDGs) through several methods such as environmental monitoring (Fritz et al, 2019). The literature of citizen science has been developing accordingly which evaluates principles, motivations also benefits and shortfalls of citizen science. By being a new sociotechnical science, citizen science comes into the view of STS.

Local developments enrich our understanding of citizen science phenomenon. Citizen science has been developing newly in Turkey where the prominent citizen science researches are consistent with the literature (Kullenberg and Kasperowski, 2016; Ferran-Ferrer, 2015) by being large scale, top down, environmental projects with NGO emphasis (Us, 2019). In order to realize an STS research on citizen science by considering the citizen science literature, the thesis problematizes how the prominent citizen science researches in Turkey have been constructed as an extension of science by the lens of actor network theory. The thesis contributes to understand citizen science phenomenon through an STS perspective and to the starting works on citizen science in Turkey. The literature review then indicates the sociotechnical development of citizen science phenomenon.

2. LITERATURE REVIEW

The literature review is a narrative review on how citizen science has been constructed by sociotechnical developments.

2.1 Brief History of Citizen Science

The historical roots of citizen science have been found in systematic works of amateur naturalists. Some of the instances are stated as phenological records in ancient China, cherry blossom records in the 9th century Japan, nature observations of Carolus Linnaeus and Robert Marsham in the 18th century Europe, amateur meteorologists' contributions to National Weather Service in the late 19th century and Christmas Bird Counts in the beginning of the 20th century (Havens and Henderson, 2013, pp.380-381). The professionalization of science period in the 19th century featuring with paid scientists and experimental sciences; and, differentiating the scientific activity of non-scientists are emphasized (Alberti, 2001; cited in Strasser et al, 2019).

The developments gathering the notions of science and public together have been stated regarding the construction of citizen science in the 20th century. Some of the developments have been stated as 1970s public health and environmental research by civil society, 1980s participatory science and society policies such as consensus conferences or science shops and the emergence of citizen science following these developments with the pioneering contributions of sociologist Alan Irwin and Ornithologist Rick Bonney in 1990s (Strasser et al, 2019). Citizen science has been constructed as a scientific method enabling research in extensive scope by the effect of developing information and communication technologies and open science movement in the 21st century (Curtis, 2018). Currently, citizen science has been occurred as a contemporary phenomenon which has been developing in academy, NGOs and policy making institutions because of its ability to generate new knowledge and to affect policy making (Hecker et al, 2018).

2.2. From Public Understanding of Science to Public Engagement with Science

Citizen science has been affected by the science and society policy developments towards public participation to events related with science, technology and society. Earlier politics refer to public understanding of science (PUS) discourse which has been characterized with deficit model based on transferring simplified science facts from expert scientist to receiver public through various channels such as media (Felt, 1999). The development of PUS in the 20th century UK referring to a variation towards participatory science and society policies has been stated as the efforts to increase science literacy in 1960s, to inform public by various channels for attitude change in 1980s and to include public to events such as science and technology deliberations or science festivals in 1990s (Bauer, 2009).

The participatory science and society politics refer public engagement with science which has been characterized with dialogue model based on participation of public with their knowledge and concerns to the collaborations with experts on issues related with science and society. Citizen Science which has been constructed as public participation in scientific research has been considered as part of public engagement with science (Bell et al, 2018). It has been stated that both deficit model and dialogue model have been continuing with the possibility of co-existence (Trench, 2008). The figure summarizing the two models is indicated below (Figure 2.2.1).

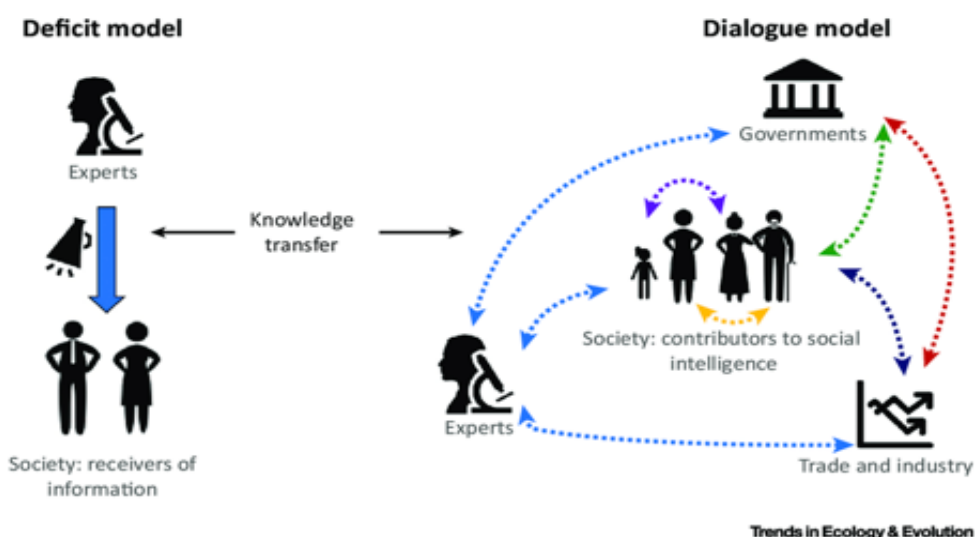


Figure 2.2.1 Two models of Science Communication (Fournier, 2016).

2.3 Citizen Science Conceptualizations of Alan Irwin versus Rick Bonney

Following the developments on participatory science and society politics, citizen science is conceptualized by Alan Irwin and Rick Bonney in the end of the 20th century. In his book *Citizen Science, A Study of People, Expertise and Sustainable Development*, Science and Technology Studies oriented scholar Alan Irwin argues that science should be constructed by considering public and their concerns in environmental crisis. In the book, Irwin mentions the cases such as farmers' battle against the toxic herbicide or industry informing to those who might live environmental hazards. Dismissing the data generated by the farmers by considering not scientific enough and the public's apathy towards hazard information are questioned by the author. Irwin stands against deficit model of public understanding of science and argues for citizen science which prioritizes agency of public in both science and policy making in order to reach sustainable development.

Rick Bonney who is an ornithologist as part of Cornell Lab of Ornithology conceptualizes citizen science in the same period as Irwin; on the other hand, citizen science conceptualization of Bonney referred to public participation to ornithology research (Cooper & Lewenstein, 2016). The relation of Bonney's efforts with National Science Foundations' participatory science and society policy objective has been emphasized (Strasser et al, 2019). Later on, as the researchers of Center for Advancement of Informal Science Education, Bonney and his colleagues have conceptualized citizen science as a participatory informal science education strategy contrary to deficit model (Bonney et al, 2009). Gradually, citizen science has been constructed as a scientific research method with educational gains.

By the emergence of online crowdsourcing citizen science projects such as "Zooniverse" (Zooniverse, n.d.), conceptualizations of citizen science have been enriched in the 21st century. The current conceptualization of citizen science as scientific method and social movement has a great scope varying from small scale local research to large scale online crowdsourcing research. The importance of variation in citizen science projects corresponding different circumstances of citizen scientists has been emphasized (Hecker et al, 2018). Considering the existing variety, several attempts have emerged in order to set a framework for citizen science.

2.4 The Definitions and The Principles of Citizen Science

As a phenomenon having roots from amateur naturalists and 1970s public health and environment researches, citizen science is public participation in scientific research not as those being researched but as researchers in various ways in the effects of information and communication technologies and open science. Oxford dictionary (2014) defines citizen science as “Scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions” (Cited in Kyba et al, 2017, p.5). The notions of public and science correspond to an extensive scope; therefore, the discussions have been continuing on the framework of citizen science.

A group of scholars from a range of disciplines have attempted to bring an international definition of citizen science for a standard evaluation. Some of the standards they have generated for citizen science are having a proper scientific method generating new knowledge, active involvement of citizen scientists, ensuring gains for all stakeholders, open access of the research, continuous dialogue between coordinators and citizen scientists, suiting ethical requirements such as transparency of research and getting participants’ informed consent; and, having a data management plan in the first stage of the research (Heigl et al, 2019). Another group of scholars have generated counter arguments against Heigl et al. (2019) by stating that the standardization attempt does not capture the variation of citizen science such as amateurs’ works and while they also emphasize the importance of informed consent on project design and transparency, they suggest applying context specific criteria to practitioners and funding institutions (Auerbach et al, 2019).

European Citizen Science Associations’ (2015) “Ten Principles of Citizen Science” refer to another pioneer standardization attempt. The principles are stated as enabling active participation of citizens to scientific activity in varied ways, generating “new knowledge or understanding” by having a science outcome for a research question, policy making etc., achieving mutual gains for both scientists and citizen scientists, sharing project data and results in open access, informing citizen scientists on project and its impacts, acknowledging citizen scientists in outputs, assessing CS programs considering their data quality, outputs, experience and broader impacts and assuring rights as well as ethical concerns.

2.5 The Citizen Science Types and The Prominent Situation

Various citizen science types have been constructed which have different research aims and methods. A well-known classification is generated by Rick Bonney and his colleagues in the report that setting the basics of citizen science. The three types are “Contributory” projects in which citizen scientists merely collect data in usually scientist generated projects, “Collaborative” projects in which citizen scientists collect data but are able to contribute other phases of usually scientist generated project and “Co-Created” projects in which some of citizen scientists design research with scientists and become active in all research process (Bonney et al, 2009, p.11). Contributory projects are attributed to large scale projects on grand problems which cannot be done by traditional research; whereas, collaborative and co-created projects are attributed to research on local problems (Dickinson and Bonney, 2012).

Later on, the classification has been extended with “Contractual” projects in which communities demand scientists to make research and inform them on the results; also, “Collegial Contributions” which has been defined as scientific works of amateurs requiring to be credited by scientific professionals and / or institutions (Shirk et al, 2012, p.4). Strasser et al. have provided a contemporary classification based on the functions of citizen scientists. These are “Sensing” which refers to data collection of citizen scientists as sensors with technological tools; “Computing” which refers to sharing computer power to scientific research; “Analyzing” which refers to crowdsourcing of online citizen science projects; “Self-Reporting” which refers to sharing personal data to the scientific research and “Making” which refers to doing science in do it yourself laboratories (Strasser et al, 2019, pp.5-6).

Bonney, Phillips, Ballard and Enck (2016) have generated four categories including education-based citizen science. These are “Data Collection projects” in which citizen scientists collect data to scientific research as parallel to contributory projects, “Data Processing projects” such as online crowdsourcing citizen science projects which are considered contributory type by the authors, “Curriculum Based projects” which refer to student participation to education based or other citizen science projects by the guidance of a teacher or an adult and “Community Science” which refers to active research effort of communities for solving their local problems which is considered as parallel to co-created projects.

There are various practical reflections of citizen science types giving a better understanding of the concept. Considering the four categorizations of Bonney et al. (2016), the examples of “Data Collection Projects” are The Cornell Lab of Ornithology’s global birdwatching database “eBird” sharing scientific data on birds collected by birdwatchers throughout the world; and, “Project Feeder Watch” monitoring situation of birds in winter with the data provided by citizen scientists across North America (The Cornell Lab, n.d.). The reflections of “Data Processing Projects” are “Galaxy Zoo” which is an online crowdsourcing citizen science project based on classifying galaxy images (Galaxy Zoo, n.d.) and “Stall Catchers” which is a video game formatted scientific research phase in which citizen scientists use their basic skills to detect stalls in mouse brain images for Alzheimer research (Human Computation Institute, 2019).

A “Curriculum Based Project” exemplified by Bonney et al. (2016) is citizen science at schoolyard program generated by Monarch Lab of Minnesota University for primary and middle school students (Monarch Lab, 2018). Finally, “Community Science” instance is realized by “Citizen Science Community Resources” group who have made air and soil quality research due to the health problems caused by a coke company in their neighborhood in Tonawanda, New York. The harm is proved by the community research supported by environmental protection agency and the company has been cancelled in the end of the struggle (Citizen Science Community Resources, n.d.).

Great variation exists on the aims and methods of citizen science projects; on the other hand, some projects are more prominent than others. The scientometric analysis of citizen science has revealed three prominent research realms which are first, “biology, conservation and ecology research” using citizen science as a method; second, “geographical information research” in which citizen scientists collect geographical data; and, third, “social science and epidemiology research” on public participation to public health and environment research (Kullenberg and Kasperowski, 2016, p.1). A similar research applying content analysis on four platforms has stated that natural and physical citizen science research in which citizen scientists collect large amount of data as suitable to European Union funding are far more than humanities and related citizen science research (Ferran-Ferrer, 2015).

2.6 Benefits and Shortfalls of Citizen Science

Scholars have stated several benefits of citizen science for society, science and policy making. Societal importance of citizen science has been stated as increasing the number of competent citizens who use science, protect the environment and engage with others through tackling with local and global challenges (Hecker et al, 2018). Citizen science has been appreciated regarding science. Scientific outputs such as increasing number of publications have been emphasized (Follett and Strezov, 2015; cited in Robinson et al, 2018). Other emphasized benefits are the inclusion of non-scientists to the scientific research with their sociotechnical concerns, contributing science by providing and processing data in an extensive scale and providing a possibility of evidence-based policy making (Shirk and Bonney, 2018).

Citizen science do not only have benefits but have many shortfalls too. One of the prominent shortfalls of citizen science has been stated as its scientific quality. The comparison of disorganized citizen science data vs. traditional monitoring program on bird distribution in Denmark has stated significant deficiency of disorganized citizen science data (Donald et al, 2016). Other scholars have reminded inefficiencies of also professional works and argue that volunteers can provide high quality data especially if the work is simple or they are experienced. For research success, a set of standards have been provided such as ongoing upgrades, volunteer training, standardization of measurements, expert verification and statistical tools to overcome errors (Kosmala et al, 2016). A philosophy of science perspective encourages contextual evaluation of each project instead of overall judgement on the scientific quality of citizen science (Elliott and Rosenberg, 2019).

Another emphasized shortfall of citizen science is its participation scope. A survey conducted in Australian marine region has stated that those who are most willing to participate citizen science projects are those who have already high science engagement and high education level which indicates a question on public engagement efficiency of citizen science (Martin, 2017). Another shortfall of citizen science regarding its participation scope is low participation. It has been stated that few active participants contribute most to the project which has been exemplified with “Pareto Principle” (Cooper et al, 2017, p.9).

2.7 Motivations and Views of Citizen Science Collaborators

From another angle, citizen science has been described as the outcome of neoliberalism embracing privatized knowledge and as filling free labor need of scientists due to decreased public fund (Lave, 2012). A counter statement asserts that citizen scientists are not free labor but are motivated volunteers especially for “values and understanding” (Seeberger, 2014, p.24). Citizen scientists have many motivations varying from autonomous motives such as personal interest to the topic, learning new things, socializing with those who share similar interests, having been in nature, getting experience for career in case of young volunteers to altruistic motives such as contributing science, protecting nature or volunteering for something meaningful (Kragh, 2016).

A comprehensive work by Geoghegan et al. (2016) has revealed motivations for environmental citizen science. The online survey with citizen scientists and environmental volunteers and the telephone interviews with stakeholders have indicated that protecting nature and contributing science are primary motivations of citizen scientists and environmental volunteers; whereas, contributing science, informing policy and conservation, education, raising awareness and engaging with people, improving collaborations and communication and, personal enjoyment are main motivations of stakeholders (pp.52-53). It has been emphasized that continuity of citizen scientists and environmental volunteers in projects depends on good project organization and “communication and feedback” (p.35). Finally, technology’s positive impact on collecting and sharing data has been stated; on the other hand, paper-based technology has not been excluded due to the possible barrier for those who are not able to use it or have access to it (p.74).

Motivations and views of ten scientists who conduct an air quality citizen science project have been researched by an in-depth study which has stated that the scientists are interested in citizen science primarily for their research and funding. The contribution of citizen scientists has been appreciated but have not been considered as doing science due to solely holding air quality sensors at their houses. The scientists find citizen science beneficial for science education and activism; on the other hand, they do not want to engage with public except the young scientists who are motivated for science communication (Golumbic et al, 2017).

2.8 Citizen Science in Turkey

Turkey has just been encountering with citizen science concept. Considering policy making, Scientific and Technological Research Council of Turkey (TUBITAK) has been funding The European Union Framework Programme for Research and Innovation (Horizon 2020) so that its ‘Science with and for Society program’ including the calls for citizen science projects; therefore, citizen science has been supported indirectly through international collaborations (Ufuk 2020, n.d.). Another citizen science related policy development in Turkey is TUBITAK’s new open science policy which is based on releasing TUBITAK researches in open access format which might influence public engagement with science (Ulakbim, n.d.).

The first works on citizen science in Turkey have made a general literature review and stated some beginning examples regarding citizen science. A few state enterprises supported by citizen generated data, an amateur meteorology forum and a policy making event encouraging citizen involvement to water research have been indicated; however, as the authors have stated, many of these works do not correspond to citizen science directly by not being open access or volunteer based projects (Anbaroğlu et al, 2017). The authors have examined the same topic by emphasizing the relation of geographical information and geospatial technologies with citizen science (Kocaman et al, 2017).

The current research has revealed existence of various projects and platforms regarding citizen science in Turkey. The prominent citizen science projects in Turkey which are close to the standards generated by Heigl et al. (2019) are NGO based, scientist or expert generated large scale environmental projects in which citizen scientists are mainly in data collection phase; and, these researches have associated with international research and / or policy making institutions in terms of methodology and / or funding. The prominent researches are consistent with the literature (Kullenberg and Kasperowski, 2016; Ferran-Ferrer, 2015). “The Turkish Breeding Bird Atlas” as part of The Second European Breeding Bird Atlas (Kustr.org, n.d.), “The National Jellyfish and Gelatinous Organisms Watch Programme” by Turkish Marine Research Foundation (TUDAV, 2014) and “The Map of Threats to Water Resources in Turkey” by TEMA Foundation (TEMA, 2016) are these prominent projects (Us, 2019).

2.9 Summary and Conclusion

Citizen science is a phenomenon which has been constructed through various sociotechnical developments. The emergence of the concept amateur has occurred after professionalization of science in the 19th century. Civil society public health and environmental researches in 1970s and the participatory science and society policies in 1980s have set participatory background of the concept. Irwin and Bonney's citizen science conceptualizations as increased agency of public in science and related policy making; and, as a participatory scientific research method with informal education gains have occurred in 1990s. Currently, it has been developing as a participatory scientific method generating new knowledge in extensive scope in the effect of information and communication technologies and open science policies (Strasser et al, 2019). Citizen science has been evolved in intersections of all these developments.

Following all these intersections, citizen science has become an extension of science in which non-scientists are not as those being researched but as researchers in scientific research in various ways. Other essential features of citizen science are stated as crowdsourcing of research data at extensive spatial and population scale which contributes data collection and data processing phases of scientific research; and, public involvement to scientific research and related policy making with their concerns (Shirk and Bonney, 2018). Scientific outcomes of citizen science such as research publications or policy progresses have been emphasized as part of ten principles of citizen science (Robinson et al, 2018). Scientific quality discussions continue with improvement efforts (Kosmala et al, 2016; Elliot and Rosenberg, 2019).

Consequently, citizen science refers to a concept challenging conventional norms of science by connecting public and science notions which have been considered distant epistemologically. Citizen science has various institutional and civil efforts generating an extension of science. The literature discusses the methodology and the factors constituting citizen science; on the other hand, a gap is found regarding a detailed description of the construction of citizen science as an extension of science. The three prominent environmental citizen science researches in Turkey are going to be described in order to contribute to understanding citizen science as an extension of science. Actor Network Theory which is a theory of describing sociotechnical science in detailed is selected to describe science formation of the citizen science projects.

3. THEORETICAL FRAMEWORK

3.1 Citizen Science by Actor Network Theory

Actor network theory which is generated by Bruno Latour and Michel Callon is one of the pioneer theories of science and technology studies. The theory refers a new approach against existing theories which conceptualize social and nature differently through constraining by particular frames. Bruno Latour has explained actor network theory in the book '*Reassembling the Social an Introduction to Actor Network Theory*' (2005) which has been selected as a guiding source of the theoretical framework. The main notion of actor network theory has been defined by Latour (2005) as a reconsideration of the concept of social against structural theories such as Durkheim's theory which conceptualizes social as a holistic entity operating behind present. Latour has been influenced by Tarde and Garfinkel's social theories which conceptualize social as a bottom up continuous generation by agents and ethnographic methods for following this generation.

By actor network theory, Latour has reconsidered social not as fixed facts but as continuous associations of entities which have been constructing facts. Social has been extended to associations of human and non-human agents including object or concept agents which have been forming "collective" in Latour's words. According to Latour, sociologist's job is to move beyond differentiated frameworks of social and nature and to describe associations generated by human and non-human entities in objective plurality. Strong agency of associations having possibility of various outcomes has been emphasized by the Latour. Considering the insights from Latour, the actor network theory analysis of 'Turkish Breeding Bird Atlas', 'The National Jellyfish and Gelatinous Organisms Watch Program' and 'Map of Threats to Water Resources in Turkey' refers to the description of the associations of human and non-human actors which have been constructing the projects as an extension of science.

3.1.2 Consideration of associations in terms of citizen science

How associations have been formed by human and non-human agents is a question to understand citizen science phenomenon as an extension of science by actor network theory. Considering how to describe agencies of human and non-human entities, Latour distinguishes, “intermediaries” carrying meaning or force without transformation as a closed form and “mediators” transforming other agents in unexpected ways with their assemblage forms. Latour states that actor network theory differs from other social theories by considering social as associations generating by mediators in which intermediaries refer to stabilized mediators (Latour, 2005, pp.39-40). Other main concepts of ANT have been stated as “actors” or semiotically “actants”, generating difference by changing the actions of other agents in associations (Latour, 2005, p.71).

The next emphasis is how to conduct actor network theory research. Latour states that one of the notions of actor network theory is to not bring social explanation to phenomena by analyst which means to not explain world by holistic structural frames. Latour argues that approaching phenomena with structural frames does not correspond objective plurality so that analyst should just describe associations which have been generated by actors themselves. Describing associations has been defined as following human and non-human mediators’ traces generating performative changes in associations. According to Latour, sociologists should leave pre-theoretical frameworks distinguishing social and nature to explain phenomena and explain phenomena itself by just describing the active associations gathering by human and non-human agents in their changing frameworks (Latour, 2005).

How do we consider the associations of the three citizen science projects? Studying the three citizen science projects by actor network theory refers to capturing detailed associations of the three citizen science projects regarding environmental concerns through describing each associations of human and non-human actors who / which act through their own actor-network upon related associations. Some of these are citizen scientists, coordinators, birds, jellyfishes, GIS technology or online maps. The task is to describe how the actors have been associated in the construction of an extension of science.

3.1.3 Translation realized by associations constructing citizen science

Sociology of translation which is cited frequently by Latour (2005) regarding actor network theory contributes to the theoretical analysis of the three environmental citizen science projects in Turkey. Michel Callon (1984) provides the main notions and analytical framework of sociology of translation within the article “Some elements of a sociology of translation: domestication of the scallops and the fishermen of St. Brieuc Bay”. Callon states that the main notions of sociology of translation are to consider cases regarding science, technology and society uncertain without bringing any social explanation or judgement in terms of “agnosticism”, to use same terminology throughout analysis of interactions in terms of “generalized symmetry” and to not separate social and nature in associations of actors in terms of “free association” (Callon, 1984, pp.221-222).

Callon has generated a specific framework in order to analyze translation of St. Brieuc Bay case. The analysis starts with construction of cultivation strategies about decrease of coralled scallops at St. Brieuc Bay. The translation has been defined with four moments of these strategy formation process. The first moment, the efforts of the three scientists by defining the related actors and their role as main part of the problem as “obligatory passage points” has been defined as “problematization”; the second moment, further efforts of the three scientists to keep related actors in the alliance by using particular devices has been defined as “interessement”; the third moment, success of interessement by reaching desired outcome through various sociotechnical interactions has been defined as “enrolment”; and, the fourth moment, emergence of the three scientists as representative of all actors has been defined as “mobilization”. The analysis ends with breaking down of the translation by the actions of the scallops and the fishermen in later years as “dissidence” emphasizing dynamism of the constructed alliance (Callon, 1984, pp.203-221).

The three citizen science projects in Turkey have a similarity with the St. Brieuc Case in terms of forming a scientific research regarding an environmental problem; therefore, Callon’s (1984) sociology of translation has been used in the analysis.

3.2 Summary and Conclusion

Citizen science reaches a different and dynamic scope by the lens of actor network theory. Various insights have been gained from Latour's (2005) explanation of actor network theory. According to these insights, citizen science consists of phenomena manifested by various associations of human and non-human actors which have been constructing dynamic networks as part of the collective. The theoretical analysis of citizen science by ANT emphasizes description of detailed associations among human and non-human mediators which have been constructing citizen science including individuals, animals, objects or concepts such as volunteering or love of nature. According to ANT, sociologist should not bring a restricted theoretical explanation to the phenomena beforehand in order to follow the associations generated by human and non-human actors' ontological plurality.

Latour has defined actor network theory as sociology of associations and translation has been emphasized in definition of sociology of associations by arguing that "there is no society, no social realm, and no social ties, but there exist translations between mediators that may generate traceable associations" (Latour, 2005, p.108). Michel Callon's (1984) sociology of translation appears in that aspect which analyzes phenomena by uniting social and nature in the same terminology and considers uncertainty and dynamism of the translation process. Callon (1984) has generated four steps of translation in which primary actors construct an alliance with other related actors towards a problem affecting them differently. The fragility of constructed alliance having possibility of unexpected outcomes is one of the main notions of sociology of translation.

Considering insights have been gained from Callon's (1984) analysis, the three environmental monitoring citizen science projects in Turkey have a similarity with Callon's case by being a formation of research strategy regarding an environmental problem; therefore, the translation steps generated by Callon (1984) facilitate the analysis of the projects by giving an ANT based framework. Consequently, citizen science by actor network theory means not explaining social explanation of citizen science but describing associations of citizen science as an extension of science which become part of the collective "in a scientific way" (Latour, 2005, p.239). The sociotechnical notions of the extension refer to important parts of the analysis.

4. METHOD

The literature review has highlighted how citizen science has been constructed by sociotechnical developments until today; however, these developments have been studied in either human centric or non-detailed way; therefore, a gap has been found for studying construction of citizen science as an extension of science by an in-depth study moving beyond social and nature or macro and micro dichotomy; accordingly, this thesis has followed qualitative research methodology and actor network theory which is an in-depth study of associations realized among human and non-human agents has been used in the methodology of the thesis.

Case studies have been considered as main elements of science and technology studies (Law, 2017). In order to conduct an STS research on construction of citizen science as an extension of science by actor network theory, multiple case study has been aimed and the three prominent large-scale environmental citizen science projects in Turkey have been selected as the cases of the thesis. Following the literature review and the methodology choice, the research question of the thesis has occurred as “How the three large scale environmental citizen science projects in Turkey have been constructed as an extension of science?”

The data collection in ANT research requires following actors’ own associations; therefore, semi-structured interview has been selected as the primary data collection tool. The cases are large scale citizen science research which include large amount of citizen scientists who cannot be studied in-depth and the literature asserts that few citizen scientists contribute most to the project (Cooper et al, 2017); accordingly, purposive sampling method has been selected by aiming to interview with the three coordinators and the three active citizen scientists of each project in order to understand how the projects have been constructed. The main coordinators have been contacted first; snowball sampling method has been used in order to reach the other participants. Finally, thirteen semi structured interviews have been made due to being interviewed with only one coordinator of the third project.

Considering the profile of the participants, the coordinators including a university professor, academia linked NGO coordinators et cetera are experts of their project topics. The active citizen scientist participants are also high educated figures including two academicians and a PhD student. The demographic profile of the participants has been stated in following (Table 4.1).

Table 4.1 Demographic Characteristics of The Participants.

Participants N = 13	Gender	Minimum Education Level	Mean Age
Coordinators N = 7	4 Men- 3 Women	Master's Degree	39
Active Citizen Scientists N= 6	6 Men	Bachelor's Degree	52

Seven face to face interviews have been made with the participants who have been based in Istanbul; four online interviews and two telephone interviews have been made with the participants who have been living in the other parts of Turkey. Informed consents have been taken from all of the participants. The interviews have lasted approximately fifty minutes in average and open-ended questions have been asked to the coordinators and to the active citizen scientists on the topics including their roles in the project, the process of the project, the reason of using citizen science method, the motivations to realize the project / to participate in the project, any factors affecting the project, any role of the technologies in the project, the role of the citizen scientists in the project, any particular profile of the citizen scientists, any relation of the project with science as well as benefits and shortfalls of citizen science method based on their project experience. The interview questions have been listed in the next page.

Interview Questions of The Coordinators

- Could you mention your role at the project?
- Why did you realize this project? (Motivation?)
- Why did you choose citizen science method?
- Could you mention how the project realized?
- Could you mention the factors affecting the project process?
- Could you mention how technology has affected the project process?
- Have citizen scientists participated in research design or data analysis phases of the project? (Any particular profile of the citizen scientists?)
- Could you mention how does the project relate to science? (Is there any contribution to scientific research?)
- Could you mention benefits and shortfalls of citizen science method after your project experience?
- Is there anything that you would like to include?

Interview Questions of The Active Citizen Scientists

- Could you mention your role at the project?
- Why did you participate in this project?
- Could you mention how the project realized?
- Could you mention the factors affecting the project process? (During data collection et cetera)
- Could you mention how technology has affected the project process? (During data collection et cetera)
- Have you participated in research design or data analysis phases of the project? (Any particular profile of the citizen scientists?)
- What is the relation of the project with science if there is any? (Is there any contribution to scientific research?)
- Could you mention benefits and shortfalls of citizen science after your project experience?
- Is there anything that you would like to include?

The interviews and the related interview transcripts of the three cases have been made from June 2019 to August 2019. The role of websites as documents have been emphasized for STS research (Shankar et al, 2017); accordingly, the project documents including the project websites and the project reports have been used as supportive documents in the data analysis. The data analysis has been made by using NVivo through coding the semi structured interviews and the project documents. The names of participants have been kept anonymous as coordinators and citizen scientists.

The coding has been made in deductive coding method by using four moments of translation and themes of citizen science literature as the nodes of the projects' data. These nodes are, problematization which refers to the associations in construction of the research problem; interesement which refers to the associations in realization of the project method along with technology which refers to the roles of the technologies affecting the project; enrolment which refers to the associations in the first outcome of the project; mobilization which refers to the associations in construction of the outcome; motivations which refer to the motivations of the coordinator participants and the active citizen scientist participants for the project; profile of citizen scientists which refers to the project's citizen scientist profile; science which refers to the relations of the project with science and scientific research; benefits which refers to the benefits of citizen science after the project experiences of the coordinator participants and the active citizen scientist participants and shortfalls which refers to the shortfalls of citizen science after the project experiences of the coordinator participants and the active citizen scientist participants. The codebooks of the projects have been included in appendices.

Each project has been analyzed separately by describing the associations of human and non-human actors as translation steps constructing the project as an extension of science. In discussion, the prominent findings of the cases have been discussed with the findings of the literature review. The limitation of the thesis is to not providing a generalizable result; on the other hand, it contributes to the insights on citizen science in Turkey, sociotechnical notion of research process, motivations of coordinators and active citizen scientists, benefits and shortfalls of citizen science as well as science relation of citizen science especially considering large scale environmental citizen science projects.

5. ACTOR NETWORKS OF THE THREE LARGE SCALE ENVIRONMENTAL CITIZEN SCIENCE PROJECTS AS AN EXTENSION OF SCIENCE

Before delving into actor networks of the three citizen science projects, I would like to introduce again Michel Callon's (1984) four moments of translation for St Brieuc Bay Case and its authentic reflections in the projects' findings. First of all, translation concept has been used by Callon as strategy formation and implementation process carried out by the researchers in case of a problem affecting related the human and the non-human actors. Translation has been reflected into the three projects as constructions of environmental monitoring projects initiated by the project coordinators on environmental issues including affected the human and the non-human actors. Callon has generated four moments of translation process. The process starts with 'problematization' in which the researchers determine case problem and the required alliance by the actors to overcome this problem. In case of the three projects' problematizations, the research problems are constructed by the coordinators within the associated network in order to solve the problems.

Translation continues with 'interessement' which includes the process of keeping the other actors in the expected alliance by using various devices. The three projects' interessement refers to the start of realizing research method through associating with the technologies. The subsequent moment is 'enrolment' which happens when the actors are enrolled to their roles by the researchers' various strategies. Unexpected developments and following associations among the human and the non-human actors are realized in the three projects' enrolment. Finally, the last moment of translation is 'mobilization' in which the outcome is constructed by the representative actors likewise the three projects' translation of the environmental situations by the enrolled actors. Dynamism of the construction is stated regarding the failed alliance of St Brieuc case in later years which also may be considered for the three projects' constructions in future. Let's delve into the projects' actor- networks.

5.1 The Construction of The Turkish Breeding Bird Atlas

The Turkish Breeding Bird Atlas¹ is the first atlas project at the national scale. The idea of the atlas has been formed by Ornithological Society of Turkey in 1970s. The first European Breeding Bird Atlas in which there was no breeding bird data of Turkey was realized by The European Breeding Bird Council (EBCC)² in 1997. The first attempts of the atlas have been made gradually by Society for The Protection of Nature in 2001 through starting pilot studies at 50x50 km squares of particular locations in Turkey; however, only one region could have been completed due to the lack of required amount of budget and birdwatchers (Atlasın Tarihi, n.d.). Following the first attempts, Kuşbank as the bird database at national scale has occurred in 2002 which later on has evolved as eKuşbank through its connection to the international eBird database in 2015 (Team eBird, 2015). The Turkish Breeding Bird Atlas has emerged following these developments as part of EBCC's The Second European Breeding Bird Atlas (EBBA2) in 2014. The atlas has been constructed by the various associations of human and non-human actors enabling the construction of the project.

5.1.1 Problematization

Breeding birds have particular features affecting the other agents such as: *"Birds are dynamic, colorful, catchy and relatively easy to be seen which make them important part of nature observation"* (1st Case Coordinator 2, personal communication, June 11, 2019). Breeding birds are selected specifically for the atlas research because of being good environment indicators; "Birds are selective in their breeding period. Adequate amount of food and security in place have vital importance for nestlings and there are complex and particular space requirements for each species representing the ecological indicators of this place" (Türkiye Üreyen Kuş Atlası, 2019, p.20). The fragility of birds in sociotechnical changes was stated: *"Birds leave when they become uncomfortable. Some also be harmed in migration and changing their fixed routine is almost impossible. When you cut that tree and build houses instead, birds cannot breed and you do not even notice it"* (Citizen Scientist 2, personal communication, July 25, 2019).

¹ Hereinafter referred to as the atlas

² Hereinafter referred to as EBCC

The monitoring of breeding birds in Turkey representing the environmental portrait has been constructed in the effect of these developments. The first coordinator of the atlas has developed and coordinated the entire process of the research through the interactions of the other human and non-human actors. The first coordinator stated the birth of the project as *“The story starts with eKuşbank. I was concerned by the stagnant situation of eKuşbank, and I started to act for proceeding eKuşbank in 2007. There are two parts of this work: one part is birds and their data, and there is social part which is providing people to enter data to eKuşbank.”* The main motivations have been stated as *“constituting tangible thing from the contributions in the name of citizen science, and proceeding these contributions one step further, the aim is always the protection of birds and the nature protection of course.”* The first coordinator has associated with EBCC which has enabled starting of the atlas:

While I had been making experiments to do the atlas, someone told me, Atlas have been done also at Europe so, why I not go there and speak with them. When I had shared my works with Europeans, they said: you are the guy we are looking for, come here to talk. I went and spoke with them, later on, they have decided to finance the project in one year. The project has developed in that way (1st Case Coordinator 1, personal communication, July 23, 2019).

The first coordinator stated the motivation of EBCC which has enabled the association:

It is very important Turkey being in Europe at European scale because many animals' dissemination area and strong population resides in Turkey, and Turkey is more advantageous than Europe at some points for conservation in terms of its geography and ecology. It is very important capturing the photograph of Turkey and Europe simultaneously for further comparisons (1st Case Coordinator 1, personal communication, July 23, 2019).

The First Coordinator stated the network which facilitated the project: *“I was not allowed to get funding individually, therefore I asked WWF Turkey to be deployed the atlas institutionally. There is small network, conservation community that when you are part of it, things become easier. It is accepted; we coordinated the project there.”* The first coordinator stated the importance of network as *“people are essential in these projects. I have been working on this for seven years and when there is support team, a friend group, we said let's do it together. It is not something that I do it myself”* (1st Case Coordinator 1, personal communication, July 23, 2019).

The other coordinators are part of the network. The other coordinators stated their motivations as *“As a birdwatcher to contribute protection of birds, but I have done it professionally”* (1st Case Coordinator 2, personal communication, June 11, 2019), and *“Interest to birds and my belief to the atlas as an important scientific work considering the works of the first coordinator”* (1st Case Coordinator 3, personal communication, July 27, 2019).

The other actors who change the research process are the birdwatchers. The birdwatchers are citizen scientists according to the terminology; on the other hand, citizen scientist attribution was not accustomed among the birdwatcher community. It has been emphasized as *“We do not use that term, we use birdwatchers”* (1st Case Coordinator 2, personal communication, June 11, 2019). The profile of birdwatchers has been stated as *“There were both those having thousands of dollars equipment, and the ones who have modest binoculars”* (1st Case Citizen Scientist 1, personal communication, July 8, 2019). Their prominent features have been stated from *“They usually have gathered in the west and metropolises of Turkey”* (1st Case Coordinator 2, personal communication, June 11, 2019) to *“Mixed profiles, but those who are high educated usually enter data”* (1st Case Coordinator 1, personal communication, July 23, 2019). It has been stated that *“Some of them normally earn money by doing birdwatching outside of the project”* (1st Case Coordinator 3, personal communication, July 27, 2019).

The motivations of the active citizen scientists are *“spreading personal satisfaction to general gain”* (1st Case Citizen Scientist 1, personal communication, July 8, 2019), *“contributing project which is wanted to happen, enjoying being in nature and believing the work of the first coordinator”* (1st Case Citizen Scientist 2, personal communication, July 25, 2019), and *“being able to contribute scientifically important project in national scale, trusting the work of friend coordinators”* (1st Case Citizen Scientist 3, Personal Communication, July 29, 2019). The breeding birds, the coordinators, EBCC and the birdwatchers have associated with each other in the problematization. In the result of the all actors’ associations, the research problem has occurred which is to monitor scientifically the current situation of the breeding birds in Turkey for conservation. The conjecture of the problematization is the participation of birdwatchers to the atlas by entering data to the database. The next stage continues with the associations regarding the methodology application.

5.1.2 Interesement

As part of The Second European Breeding Bird Atlas, The Turkish Breeding Bird Atlas has a particular methodology which is determined by EBCC. EBCC committee, the first coordinator and the ornithologists gathered in Turkey in March 2014 in order to discuss feasibility of the atlas. They have determined realizing the project and a pilot field work has been conducted with birdwatchers in order to apply the atlas method (Atlasın Tarihçesi, n.d.). The coordinators stated their participation accordingly: *“When I heard that EBCC is coming to Turkey, I participated to the pilot project. When I encountered with the first coordinator, I was reminding the atlas, and I was called in the start of the project in 2015”* (1st Case Coordinator 3, personal communication, July 27, 2019). *“I called to participate voluntarily, I participated to atlas professionally later on”* (1st Case Coordinator 2, personal communication, June 11, 2019).

The citizen science type of The Turkish Breeding Bird Atlas corresponds the contributory type (Bonney et al, 2009) by assigning the citizen scientists solely in data collection of the research process. The first coordinator stated that the atlas is related with a certain group: *“This work is related with really expert group. In fact, it is addressing to experts at universities, ministries and birdwatchers; two or three thousand people. It is not a popular thing; let’s say ten thousand”* (1st Case Coordinator 1, personal communication, July 23, 2019). The required expertise in the data collection has been emphasized: *“You should know birds, not just knowing birds, you should know their sounds, there are determined breeding bird codes on particular categories. There should be definitely someone doing birdwatching very well”* (1st Case Citizen Scientist 2, personal communication, July 25, 2019).

Although some birdwatchers have been stated as very amateur, their contributions have been considered essential: *“If they were not, I would not do fieldworks because they drove car; I had not driving license; I made twelve days fieldwork with a volunteer; The volunteer worked like crazy; spent time for solely making a contribution”* (1st Case Coordinator 3, personal communication, July 27, 2019). The other indirect volunteer contributions to the project have been stated as *“rather than methodological part, we discussed altogether how we can conduct this*

work in this country” (1st Case Coordinator 2, personal communication, June 11, 2019). The dynamic process of the research has been emphasized: *“The project updated and renewed itself constantly; something participated to the project constantly”* (1st Case Coordinator 3, personal communication, July 27, 2019).

The atlas method has a complex process. It was planned to realize data collection in 2014-2017, and to realize data analysis in 2018-2019. The atlas method has two parts as periodic and random work. Turkey was divided to 375 50x50 km geographical squares. The squares were divided to half by aiming to capture the breeding birds in 166 squares due to the limited birdwatcher count and financial conditions. Each birdwatcher was encouraged to work in one 50x50 km square. 50x50 km is a large area; therefore, two 10x10 km regions having different ecological conditions were selected in each 50x50 km. As the periodic work, the birdwatchers were previously expected to do four one-hour 1x1 km field works in each 10x10, then it was changed. It was stated that the reproduction period of breeding birds varies from March 15 to July 31, therefore two visits were planned; one in the early reproduction period from March to May, and the other one in the late reproduction period from May to July. The random work was planned as doing random monitoring of breeding birds in the each 50x50 km (Türkiye Üreyen Kuş Atlası, 2019, pp.26-29).

The associations with some technologies have enabled the methodology of the atlas. The coordinators have associated with the technologies as applying interessement devices for realizing the research problem as they expected. The first coordinator stated the technologies’ role as *“My experience with geographic information systems was an advantage. GIS is important in the data processing through filtering data or dividing squares.”* It has been stated that *“Atlas squares have become concrete things; generating maps is so easy now. We have generated our own maps by adjusting the grid system to European standards which is different than Turkey”* (1st Case Coordinator 1, personal communication, July 23, 2019). The birdwatchers have applied these technologies in their field works: *“The coordinators were sending us maps in pdf format which facilitated choosing location and staying in coordinates; besides that, we were required to use eBird database which is easy to use; we were entering data there actively”* (1st Case Citizen Scientist 3, personal communication, July 29, 2019).

The inclusive effect of the GPS technology has been emphasized: *“It would be so hard to realize this project if it was not GPS feature of telephones; increase of these technologies have facilitated our job by the access of amateur birdwatchers”* (1st Case Coordinator 2, personal communication June 11, 2019). The difference in using technologies has been stated as *“Some birdwatchers prefer classical ways by taking notes to notebook; especially young birdwatchers used telephone apps more; they entered data by using eBird.”*. The dual effect of technology has been emphasized *“It protects your data becoming vague in rainy days, but you may risk your data as well by breaking your telephone; it happened to me”* (1st Case Coordinator 2, personal communication, June 11, 2019).

As another intersement device, the data collection was realized by using an entry form including the species list and the sixteen breeding codes which categorized as potential, likely and highly likely to breed. In fieldwork, it was expected to enter the breeding codes of observed species to the online database.

The Coordinators have applied various strategies in order to keep birdwatchers in the research. It has been stated that:

People had not done the methodology before. They were contacting us to contribute to the atlas. By filling a survey, they were sending us information on what resources they have and where they want to work on, later on I was phoning them to inform methodology, I was also sending them long emails explaining the methodology. I went every part of Turkey from Yüksekova, Posof, Edirne, Black sea region to Region of lakes. My key role was to go next to them. If we had let them, they would not do that; they would send us low quality data. I taught them how to use the GPS and the breeding codes; we made first fieldwork together; later on, we expected them to send us the data of other regions. In order to keep them motivated, it was required to give people feedback. I was posting selfies with them on Facebook by explaining what we made that day. The social media posts were important because people like to be seen, they like to see their work be valued. We made videos, we made posts about birds. We prioritized their work ex cetera ex cetera (1st Case Coordinator 3, personal communication, July 27, 2019).

The constructed research plan has encountered with following developments.

5.1.3 Enrolment

Participation of birdwatchers by entering data to the database was very important for realization of monitoring the situation of breeding birds in Turkey; however, it could not be reached adequate participation. A few more than 150 birdwatchers have realized monitoring at 127 50x50 km squares throughout Turkey. Various associations were stated affecting the low participation. The associations from the volunteer behaviors, the personal conflicts to the political conflicts of Turkey have transformed the research process. The first coordinator stated the volunteer behaviors as *“those who take photo first transfer photo to computer; upload it; find the species and its location; do this, do that; people were not doing it by saying it is too long”* (1st Case Coordinator 1, personal communication, July 23, 2019). The circulation problem was emphasized *“when I look at the number, 200 people are not changing; but, %50 of them are leaving; we have so much circulation; it was something that I never thought of it.”* (1st Case Coordinator 1, personal communication, July 23, 2019).

The fragmentation of birdwatchers at particular period was stated as another effect on the low participation:

Turkey is a community society. People are divided in groups. Many people prefer being in a group. There are group identities. I thought that we could be effective in assemblies by gathering birdwatchers together; however, it came up to the period when people divided into groups. New associations emerged; existed ones changed their strategies; the institutions which were doing Mid-Winter Bird Counts got into competition. We have not gathered together yet by finding a common ground. Because of coming up to this fragmentation period, we were struggled on gathering people to the Atlas (1st Case Coordinator 1, personal communication, July 23, 2019).

The personal conflicts were emphasized regarding the low participation of the atlas. The first coordinator stated the personal conflicts:

Many people decided not to participate to the project because they were upset with me. We tried to involve them through other people. They accepted to go to the fieldwork with those whom they were close with. There was very complex and sensitive point. (1st Case Coordinator 1, personal communication, July 23, 2019).

The political conflicts were stated too as another effect on the low participation:

To tell truth, the political situation of the country in 2015- 2016 impacted us badly. We were aiming to sustain foreign birdwatchers' contributions too; however, because of their unrest towards political situation of Turkey, both Syria crisis and internal conflicts, they did not want to come. While we were aiming so much more volunteers and many qualified birdwatchers, we completed the project with limited volunteers in our country. It affected us seriously (1st Case Coordinator 2, personal communication, June 11, 2019).

The density of birdwatchers in particular part of Turkey and the financial constraints were also stated as the effects on the low participation:

Birdwatchers usually are living in metropolises and at the west so that the project realized in particular places; also, economic situation of people is not very good in Turkey. There is a big cost for a birdwatcher who is based in Istanbul to go to Elazig to do fieldwork. We were hesitating to ask people to do this. It was a limiting factor (1st Case Coordinator 2, personal communication, June 11, 2019).

The enrolment was also challenged by the hardship of the previous periodic work and the volunteer's busy schedule. It has been stated that *"We were doing four works at 1x1 km areas; fitting four works in one day was a problem. People could not allocate more than one day in weekdays; this was the main problem"* (1st Case Citizen Scientist 3, personal communication, July 29, 2019). The hardship of methodology again was stated:

We were completing two 1x1 km works till 11 A.M, if you were trying to do four works, you had to work after 11 A.M; however, bird activity was decreasing seriously after that time in hot days and it was a serious performance loss for you as well (1st Case Coordinator 3, personal communication, July 27, 2019).

The birdwatchers who enrolled to their roles have been affected by the associations with the other agents in their data collection. It has been stated that *"We are greeting with people when we are crossing somewhere. They think that we are treasure hunter. People are living in their fantasies classically. In countryside, we met very good people, but we have encountered very suspicious friends too"* (1st Case Citizen Scientist 1, personal communication, July 8, 2019).

In associations, the method was considered effective: *“Procedure is so strict you cannot act as you want”* (1st Case Citizen Scientist 2, personal communication, July 25, 2019). The security intervention was reminded; *“In random work, I encountered with military border zones, I stopped the timer of the work, got permission from soldier and started to work again. It was not a serious obstacle”* (1st Case Citizen Scientist 3, personal communication, July 29, 2019).

Various strategies were developed in order to overcome the low participation and the methodology hardship. Conducting coordination meetings with birdwatchers was one of these strategies. A workshop was conducted which was hosted by Samsun 19 May University Ornithology Research Center in October 2015. Thirty birdwatchers attended to the workshop throughout Turkey. A fieldwork was made in Kızılırmak Delta. The meeting helped to increase the atlas participation. The second workshop was conducted in Hacettepe University Biology department in October 2016; fifty birdwatchers attended to the workshop. The first findings were shared with the attendants. The project’s shortfalls and how to optimize the research in 2017 were discussed (Türkiye Üreyen Kuş Atlası, 2019, p.16). It has been stated that *“We spent some of the project budget to the flights of people in order to bring them to the meetings”* (1st Case Coordinator 1, personal communication, July 23, 2019). The consensus seeking in the meetings was emphasized: *“We talked how project were going to proceed and how it should be. They became educated and shared their own views. A consensus was sustained. The other workshop was also aiming education and sustaining consensus”* (1st Case Coordinator 3, personal communication, July 27, 2019).

The meetings were not limited with the two main workshops. The coordinators have associated with the policy makers by mentioning the research to The Wildlife Unit of The Directorate of Nature Conservation and National Parks in March 2017. In 2016-2017, Several regional meetings from Istanbul to Kaş were conducted with the project volunteers and local birdwatcher groups for realization of the project as it was expected (ibid.). The project team participated to an international conference in 2016. EBCC conducted its fourth meeting in this conference and an association was constructed for overcoming hardship of the periodic work. It was decided to simplify the periodic work by reducing the four 1x1 km works to the two 1x1 km works in each 10x10 km square (Türkiye Üreyen Kuş Atlası, 2019, p.17).

The method change was evaluated by one of the citizen scientists:

It is actually an easy method theoretically; however, there were either monetary or time problems in Turkey's conditions. We were discussing how to improve that; at the same time, we were told by EBCC that it is statistically adequate to work in two 1x1 km (1st Case Citizen scientist 3, personal communication, July 29, 2019).

The method was improved, the birdwatchers started to participate, but the atlas still could have not reached the adequate data. The first coordinator has associated with The Catalan Ornithologist Institute experts on solving inadequate data problem in March 2017. "It has been decided to include all the records having the breeding codes and the completed regional atlas data since 2000 in Turkey to the atlas" (Türkiye Üreyen Kuş Atlası, 2019, p.17). Also, "the records collecting through EBCC and categorized according to the atlas squares have been included to the data pool" (p.37). The data having no breeding codes too have been added through specific filter and expert revision (p.36). It was stated that: "*We compiled breeding bird data we received except the project. We made a meeting. Those who participated to the meeting gave their own data.*" (1st Case Citizen Scientist 2, personal communication, July 25, 2019).

The breeding birds in Turkey have been constructed as data in result of the associations of the breeding birds, the coordinators, the ornithologists, the birdwatchers and the GIS technologies. The field work data and the other data in Kuşbank have been translated into the datasets. Thirty-five-thousand-line dataset have occurred consisting of the highest breeding bird code, the latest observation year and the 50x50 km of each breeding birds. The densities of the breeding bird species in each 50x50 km were estimated through associating with the old data, the periodic work data and EBCC's specific technique. The density of some breeding bird species requiring different circumstances could not be captured. The estimated population densities were included to the dataset. The dataset was translated into the online maps which later were analyzed and edited by the scientific committee consisting of the ornithologists and the expert birdwatchers in 2017-2018 (Türkiye Üreyen Kuş Atlası, 2019, pp.37-39). Monitoring the situation of breeding birds throughout Turkey by providing the birdwatchers' data entrance could not be achieved as it was expected; on the other hand, the associations generated by the human and the non-human actors have constructed an outcome realizing The Turkish Breeding Bird Atlas.

5.1.4 Mobilization and the occurrence as an extension of science

The whole research process consisting of constructing alliance, applying methodology, generating strategies about shortfalls and enrolment of the actors has been translated by the three coordinators into the Turkish Breeding Bird Atlas report published in October 2019. The findings have indicated that “313 of 400 regularly seen birds continue to breed in Turkey” (Türkiye Üreyen Kuş Atlası, 2019, p.40). The prominent changes of breeding birds in Turkey have been stated in the report. According to these changes, three breeding bird species, Red-footed falcon, Sykes’s Warbler and White-eared Bulbul have been monitored for the first time; however, another three breeding bird species, Marbled Teal, Demoiselle Crane and Velvet Scoter could have not been monitored; which has revealed extinction of breeding population of these three species in Turkey (Türkiye Üreyen Kuş Atlası, 2019, p.40).

Other emphasized findings are the high existence of some breeding bird species such as European Turtle-Dove, Eurasian Skylark, Red-backed Shrike and Ortolan Bunting contrary to their declined population in Europe and occurrence of three new foreign species, Rose-ringed Parakeet, Alexandrine Parakeet and Common Myna which have been living in urban areas (ibid). Breeding levels and estimated breeding pair population of 316 breeding bird species in each 50x50 km squares of Turkey have been reflected into the distribution maps in the report. The distribution and abundance map of Sardinian Warbler has been stated below (Figure 5.1.5.1).



Figure 5.1.5.1 The Distribution and Abundance Map of Sardinian Warbler (Türkiye Üreyen Kuş Atlası, 2019, p.44).

The atlas has enabled comparison of the findings with the earlier works. The dissemination decreases of Grey Partridge and Montagu's Harrier have been observed through such comparison; on the other hand, the hardship of detecting any decrease of the prevalent species such as Eurasian Skylark, White Stork and Common Quail has been stated (Türkiye Üreyen Kuş Atlası, 2019, p.41). Agency of non-humans and associations of human and non-human actors on the findings have been emphasized in the report. It has been stated that diversity of Turkey's ecology has enabled breeding of 313 species; however, extinction of various species has also been happening in such biodiversity due to sociotechnical problems such as effects of agriculture type, wrong way of grazing, careless industrial acts, poaching or the effect of climate change (Türkiye Üreyen Kuş Atlası, 2019, pp.40-42).

Even a moment carrying shortfalls of the past may cause extinction of an endangered species. The extinction of a species has been estimated in that manner:

The reason is probably twenty cows. They are entering reeds in which the marbled teal breeds; while they are walking, they are scaring the duck and crushing if there is the nest. Only one farmer should have had to take off the twenty cows out of the reeds. It could not able to intervene one farmer entering reeds with the twenty cows. It is something so simple (1st Case Coordinator 1, personal communication, July 23, 2019).

Required conservation efforts and the role of atlas for policy making has been stated:

The bird atlas is partly intended for policy makers. Something they can use easily. We want them to use. When The Directorate of Nature Conservation and National Parks is conducting a work, when they up to change something in somewhere, when a situation occurs to make a decision or to state an opinion, when they open and look, to be able them to say, you do not do the thing you want here because endangered Bonelli's Eagle is breeding there; constituting a base for them to use too (1st Case Coordinator 2, personal communication, June 11, 2019).

Besides the report, the coordinators have translated the atlas research into the website Kustr.org; in which, the research process, the methodological information and the pilot maps have been shared in open access which is compatible with the open access principle of ECSA's (2015) ten principles of citizen science. Dynamic process has been stated by upcoming EBBA2 book in 2020 and the planned Second Turkish Breeding Bird Atlas in 2021-2025 (Türkiye Üreyen Kuş Atlası, 2019, p.12).

By the associations of the actors, The Turkish Breeding Bird Atlas have been constructed as an extension of science. The relation of atlas with science was stated:

There are two kinds of work; Some kind of works identify a fact by thesis or hypothesis; the others are descriptive works forming required data background for being able to do scientific work. The bird atlas is something like that. There is going to be scientific or practical works after that. (1st Case Coordinator 1, personal communication, July 23, 2019).

The scientific contribution of The Turkish Breeding Bird Atlas as the first atlas at national scale has been stated:

We had many backing data deficits regarding bird related conservation. One of the most serious deficits was could have not being able to be done our breeding bird atlas at national scale until today. There were various local studies; however, because we live in very big geography; a work exactly ecologically representing so much geological, latitudinal and climatic variety of vegetation of the country had not been produced. It is a very important step in terms of responding to this need. It is going to provide serious backing data to next conservation research. There is a very important contribution in this respect (1st Case Citizen Scientist 3, personal communication, July 29, 2019).

The scientific quality of the atlas and the ability to be used by scientists have been stated; *“It has been developed with wholly scientific background. We have expressed everything scientifically in a way that can be used in all kinds of scientific research. A scientist can get and use these data easily”* (1st Case Coordinator 2, personal communication, June 11, 2019). The scientific outputs out of the atlas research have been emphasized by Coordinator 3. Herrando et al., (2019) have analyzed the scientific impact of The First European Breeding Bird Atlas. The authors have indicated that EBBA1 has contributed 3150 scientific publications mainly on distribution and ecology. The deficiency of EBBA1 which has been stated as its data deficit at Eastern part of Europe has been compensated by Second European Breeding Bird Atlas including Turkey. Considering Turkish Breeding Bird Atlas, an awarded academic poster in an international conference (Türkiye Üreyen Kuş Atlası, p.17), the articles out of the project (Dizdaroğlu et al, 2017; Dizdaroğlu and Boyla, 2017) and a master thesis analyzing the community types of the breeding birds by using systematic data of the Atlas (Sinav, 2019) have been produced.

The Turkish Breeding Bird Atlas has been associated with science directly: *“There is a direct connection. I know that bird behaviors are suited with nature. We see how polluted nature affected water resources or how agricultural areas or increase of husbandry affected these areas and the bird species.”* The atlas has been described as *“It is a reference book. It is not something to be outdated next year”* (1st Case Citizen Scientist 1, personal communication, July 8, 2019). A critical response has been stated that *“Certain contribution to scientific work but it should be done more densely. Europe has more birdwatchers; birdwatching is more prevalent there; here, photographs, better photographs, getting likes are more prioritized”* (1st Case Citizen Scientist 2, personal communication, July 25, 2019).

The scientific methodology of The Turkish Breeding Bird Atlas has been emphasized regarding the association of the atlas with science:

It includes a direct scientific method. Monitoring is not something scientists should do, but the method you apply while monitoring is scientific. You use a counting method and behavior codes totally suiting a scientific method and behavioral sciences; hence, the technique applied in the project is relying on scientific methods; its' analysis part is wholly something about scientific analysis (1st Case Citizen Scientist 3, personal communication, July 29, 2019).

The coordinators explained the reasons of using citizen science methodology: *“Birdwatchers are collecting so much more data than scientists. There are mistakes. You need to analyze these data too; on the other hand, the mass we have at our hands are very big”* the birdwatchers have been found advantageous in many ways *“There are 200-400 active birdwatchers who enter data to internet year to year. Probably there are 10-20 ornithologists in Turkey. How often they go to field? The Birdwatchers are more active and braver. Some of them have more resources”* (1st Case Coordinator 1, personal communication, July 23, 2019).

Large scale monitoring and getting continuous and actual data through online platforms have been emphasized:

A very big country. We had no choice to gather these data ourselves. You need continuous and actual data when you do an atlas work. When you include more people with citizen science, especially through online platforms, it is easier to notice changes and to get actual data (1st Case Coordinator 2, personal communication, June 11, 2019).

The extensive scale and data continuity were emphasized similarly: “*EBCC is monitoring more than 500 species at more than 50 country and more than 5500 50x50 km. It is covering very large area. There should be human power for it.*” The importance of citizen science was regarded in that aspect: “*Citizen science is important because of providing more comprehensive and continuous data flow that’s why we embraced it actually*” (1st Case Coordinator 3, personal communication, July 27, 2019).

The benefits and shortfalls of citizen science were stated following the Atlas experience. The coordinators stated large amount of data collected by mass at extensive scale as benefit: “*you collect data from much more big mass. Data can be entered from every part of Turkey; the data provided from an extensive geography*” (1st Case Coordinator 1, personal communication, July 23, 2019). Massive data by birdwatchers were stated: “*Birdwatching is becoming widespread day by day as well as bird photography. They provide an incredible data on purpose or without being aware of it*” (1st Case Coordinator 3, personal communication, July 27, 2019).

The mobility of citizen scientists and the effect of online platforms were stated: *People are everywhere. Most of birdwatchers are at Istanbul and Ankara but they are mobile, they can go on weekends. It is not possible doing the work from nine to five. It is becoming more flexible when it is done in sunrise. Existence of eBird is so important; data entrance of people to eBird from everywhere. For instance, I do that; I am recording some species while I am passing a road. There are people continuously doing it too. It has huge advantages in terms of coming data from everywhere and receiving actual data* (1st Case Coordinator 2, personal communication, June 11, 2019).

Eliminating costs is another stated benefit: “*You are eliminating all costs like accommodation, car or expert*” (1st Case Coordinator 1, personal communication, July 23, 2019). Considering the shortfalls, the coordinators stated the low participation and the volunteer management:

People are not doing that for a provision, what they expect is just a thank you and being part of the work, but they do not earn money eventually, their professional lives are continuing as well, therefore the effort they are giving to the project is decreasing. The work you expect from a citizen scientist is limited; you cannot expect as much work as from a professional (1st Case Coordinator 2, personal communication, June 11, 2019).

The volunteer management and the required good human relations were stated:

Adhering volunteer participation, not just in data collection, there are issues like data analysis. I should call and persuade as 'Brother, we collected the data; could you look at them?' Participating to a meeting is voluntary, his/her time should coincide convenient time; on the other hand, you should have very good human relations. People should trust (1st Case Coordinator 1, personal communication, July 23, 2019).

The low-quality data requiring edit were also stated: *"Incoming data should be controlled seriously. Did he/she say hawk instead of crow? There are records in such absurdity too"* (1st Case Coordinator 3, personal communication, July 27, 2019).

The active citizen scientists stated several benefits, such as the systematic method generating strong data at large scale:

I can say that producing powerful data by methods applied in same way is the most important part of this job. It is not possible for a few people to monitor a big country like Turkey. Only citizen science can make such serious data pool, because the amount of educated people or people who have monetary or logistic resources are low (1st Case Citizen Scientist 3, personal communication, July 29, 2019).

The increasing awareness was stated but was found inadequate; *"Maybe a consciousness occurred in community on making research and programs; however, there was not an awareness as far as the degree of seriousness of the project after all"* (1st Case Citizen Scientist 2, personal communication, July 25, 2019). The bureaucracy support was also stated but was found inadequate; *"When you interact with the directors related with conservation and tourism, you mention how big their contribution is, it turns you as 'let's help you', so there is support but it is not enough for now"* (1st Case Citizen Scientist 1, personal communication, July 8, 2019).

Considering the shortfalls, the low participation was stated:

I think that it is in development stage yet. Because we tend to consume instead of produce, I think the amount of people who consider participating to the work without monetary provision is limited. Usually people are coming with expectations. Not just monetary expectations but students carry concerns on their career prospects. Volunteering is already a bit controversial in our country. It is formatted as I give my promise, but I can give up in last moment. I think it

is one of the things of citizen science should be solved. Even it is not for The Atlas Project, there is a volunteering understanding not sustaining promises in many projects (1st Case Citizen Scientist 3, personal communication, July 29, 2019).

The fieldwork inhibition was also stated: *“Military police said gentlemen do not walk around there much. If you mean any inhibition or negativity, I can say this kind of thing”* (1st Case Citizen Scientist 1, Personal Communication, July 8, 2019).

Summarizing the findings is important for a clear understanding. The Turkish Breeding Bird Atlas has been constructed as an extension of science by the associations of the human and the non-human actors. The actors who/which have various features and motivations have associated by forming a network constructing the project. The selective feature and fragility of breeding birds in the environment have made them important actors for the atlas project indicating the environmental situation of Turkey. The GIS technology, the GPS technology and the online databases are also actors which facilitated the birdwatchers’ data collection at national scale and the coordinators’ data analysis.

Considering the human actors, the coordinators’ motivations are ranged from realizing national bird atlas, bird conservation, personal interest to birds to believe the atlas as an important scientific work by knowing the first coordinators’ works. The motivation of EBCC was stated as extending European atlas by the inclusion of Turkey. The birdwatchers who were described as mixed profile mainly living in the west and entering data when they are high educated are other actors. The active citizen scientists’ motivations ranged from turning personal satisfaction to a general gain, to contribute to the project, enjoying being in nature, to believe the first coordinators’ work and to believe the familiar coordinators’ work. The human and the non-human actors have associated in the four moments of translation in construction of the atlas.

In problematization, for proceeding the national bird database attempts which previously could not be achieved because of financial and birdwatcher constraints, the first coordinator has associated with EBCC and the atlas started by inclusion of Turkey to The Second European Breeding Bird Atlas in 2014. The first coordinator emphasized the network by referring to the institutional and other collaborations in the conservation community. It was aimed to monitor the situation of the breeding birds in Turkey by providing the data entrance of the birdwatchers.

In intersement, the research method has been constructed. The data collection was planned in 2014-2017. At first, four one-hour morning 1x1 km periodic works in two different featured 10x10 km in each 166 50x50km square of Turkey were expected to be realized in two breeding periods from March to July within the random monitoring in each 50x50 km squares. Online mapping, eBird app and the data entry form are intersement devices, which enabled access, navigation and data entrance of the birdwatchers. The birdwatchers were ascribed in data collection and it was described as an expert birdwatcher work; on the other hand, the amateur birdwatchers' contributions were prioritized. The third coordinator went to various parts of Turkey, made the first fieldwork with the birdwatchers by teaching the method to them. The rest of the data entrance was expected from the birdwatchers by keeping social media alive for communication and feedback.

In enrolment, only few more than 150 watchers entered data at 127 50x50 squares. Volunteer circulation, fragmented community, personal conflicts, political conflicts in Turkey, unbalanced birdwatcher distribution, financial constraints and volunteers' schedule affected low participation. The volunteers could not allocate enough time against demanding methodology. The coordinators developed various strategies about the shortfalls. The regional meetings increased the participation and following the contacts with the EBCC experts, the methodology was simplified, and it was decided to add prior data since 2000. In 2018-2019, the data were analyzed and edited by the scientific committee and an outcome has been reached realizing the Turkish Breeding Bird Atlas.

In mobilization, the situation of the breeding birds in Turkey has become data then, the data were translated into the online maps. The distribution, abundance and breeding state of 316 species were indicated through mapping. The research process, the findings and its' analysis were translated by the coordinators into The Turkish Breeding Bird Atlas report published in 2019. Humans and non-humans' effect on the findings have been stated. The importance of the atlas for conservation has been emphasized. Besides the report, the research has been translated into a website as consistent with citizen science's open access principle. Dynamism of the process has been stated with the upcoming 2EBBA book and The Second Turkish Breeding Bird Atlas in 2021-2025. The Turkish Breeding Bird atlas has been constructed as an extension of science accordingly. The atlas is the first breeding bird inventory at

national scale. It was described as a descriptive work, a reference book providing data for further scientific research. The scientific methodology of the atlas was emphasized. The scientific outputs of the atlas were stated. When the reasons of using citizen science methodology were asked, the coordinators emphasized getting continuous and actual data by mass at large scale. Considering the benefits and shortfalls of the citizen science method, the coordinators stated collecting data by a bigger mass at large scale, getting actual data from everywhere provided by mobile citizen scientists through accessible online databases and eliminating costs as benefits; whereas, low participation, volunteer management and low data quality requiring editing were stated as shortfalls. The active citizen scientists stated generating data by systematic method at large scale, starting awareness and bureaucracy support as benefits; whereas, low volunteering and fieldwork inhibition were stated as shortfalls on their experience.

5.2 The Construction of The Map of Threats to Water Resources in Turkey

Water is an essential entity for sustainable environment. Water stands at the center of world's network consisting of associations regarding survival and development. Fresh water is % 2,5 of the water amount in the earth and there is limited accessible fresh water which is % 0,4 of whole amount of fresh water (TEMA Vakfı, 2016, p.5). Water as a life source of biodiversity and as a resource of agriculture, industry, daily consumption et cetera is being threatened due to many harmful associations. In order to determine such threats, Turkish Foundation for Combatting Soil Erosion, for Reforestation and Protection of Natural Habitats shortly TEMA Foundation's³ The Map of Threats to Water Resources in Turkey occurs as another citizen science project.

The project is part of "ENV.net factoring the environmental portfolio for WB and Turkey in the EU policy agenda" aiming to develop its member states' evidence-based policy making (Env.net, n.d.). The project is influenced by "The Map of Environmental Justice" project revealing the environmental threats indicated by communities throughout the world (Ejolt, n.d.). A similar project called "Türkiye Çevre İhtilafları Haritası" was tried to be realized however it could not be achieved. The first coordinator who was part of the previous effort created The Map of Threats to Water Resources in Turkey in 2016 with the associated network.

³ Hereinafter referred to as TEMA

5.2.1 Problematization

Turkey's water resources are the main actors alarming in order to be conducted research. "Considering Turkey's 112 billion m³ accessible water and 2010 census, Turkey has 1.519 m³ water per individual in a year, which makes Turkey a water scarce country in terms of international standards" (DSİ; cited in TEMA Vakfı, 2016, p.4). While Turkey's population have been increasing, it is expected to be water poor country by 2050. Turkey's water resources are used as %74 in agriculture, %11 in industry and %15 in houses. To crop yields using excessive water in water scarce fields in agriculture, non-refined water use in industry and capacity imbalance of water resources vs. urban consumer population cause water shortage, water pollution, access to water problem, low quality production and rural migration (Tema Vakfı, 2016, pp.5-6).

Considering the alarming water resources, the first coordinator who had previous mapping experience created the project with EU association. The first coordinator stated that "*We carried out the project in 2016. In 2016, I was working in TEMA as project coordinator; the project was part of an EU project called env.net at that time*" (2nd Case Coordinator 1, personal communication, June 14, 2019).

The first coordinator stated the goal and motivation to actualize the project:

First of all, there is a pragmatic part. We had to do something at the project we were coordinating. There was a budget, a thing related with water as one of the main themes. I had mapping experience; I said we can make a map; it was accepted (2nd Case Coordinator 1, personal communication, June 14, 2019).

The citizen scientists are other main actors of the project. The first coordinator explained the profile of the citizen scientists in that manner:

Not everyone. Most of them are the TEMA representatives because they were told to do so. Many of them are the TEMA volunteers, very few of them are people who entered by seeing this at internet coincidently. The profile is a certain group who are more or less describing themselves as environmentalist and trying to do something for environment. We are referring to a very small thing at Turkey. The environmentalists who follow TEMA but not those who follow Greenpeace or WWF (2nd Case Coordinator 1, personal communication, June 14, 2019).

The active citizen scientists also stated the profile of the project's citizen scientists:

These people are patriots in love with leaf, in love with soil. They do not look out their own interests. They take societal and national interests forefront. There is no ethnic, socioeconomic or political discrimination among them. They gather for their common purpose, not for daily barren politics. There is no separation among them, the friendships are strong as well (2nd Case Citizen Scientist 1, personal communication, August 6, 2019).

“No, our representatives change time to time. There are academicians, teachers, technical personals, there is an agricultural engineer who I know, there is advocate too” (2nd Case Citizen Scientist 2, personal communication, August 7, 2019). *“No”* (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

The active citizen scientists who contributed to the project mentioned their various motivations which are *“Having NGO mission, volunteering, interest and sensibility to environment, having geography branch”* (2nd Case Citizen Scientist 1, personal communication, August 6, 2019);

First, Being TEMA foundation representative and this work done by TEMA. Second, my high school branch, my profession and my undergraduate thesis are related with environmental studies. Both I had to support the work done by TEMA and I was required to participate to the project because of my personal relation and sensibility to environment (2nd Case Citizen Scientist 2, personal communication, August 7, 2019);

I have been working related to water for long years. First hydroelectric power station project at Çamlıhemşin Firtına Valley in 1996. I started with the HEP project there; it was a project against more than 80 HEP project using water resources for energy purposes, pulling off from nature at there. We had monitoring, accumulation struggle from there. We contributed to a thing like this easily (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

Finally, the first coordinator has constructed the research problem with a colleague who was directing TEMA education unit. The first coordinator stated that *“Actually, he was the one who thought it can be used to teach the representatives; by writing something there, they go and research, learn by doing”* (2nd Case Coordinator 1, personal communication, June 14, 2019).

Accordingly, the first coordinator stated the educational aspect of the project:

We make them think things they never think before. We say put this problem to a category. They think and put it that's why it becomes a learning process we made this as an education work. Both for getting information and for people to learn something (2nd Case Coordinator 1, personal communication, June 14, 2019).

The research problem has various notions stated by the first coordinator as to monitor the threats of water resources throughout Turkey by the research of TEMA representatives who are later extended to the public, to learn unknown local information on water resources, to provide an awareness raising activity for TEMA representatives and later for public in order for them to learn the water threats around them by doing research; and, to use the map as evidence base tool for environmental policy-making (2nd Case Coordinator 1, personal communication, June 14, 2019).

In the result of the actors' associations, the research problem has been constructed first as to monitor the threats to water resources in Turkey by the research of the TEMA representatives and to make them learn the water threats around them by doing research. Later on, the research problem was extended by aiming at raising an awareness and activation of everyone about the water threats around them. Using the acquired knowledge as advocacy in policy making is another part of the research problem. The next phase includes the associations regarding the methodology of the research problem.

5.2.2 Interessement

The research method of The Map of Threats to Water Resources in Turkey has been planned as collecting the threats of each province's water resources by the documentation of each volunteer city representatives through using the online information form provided by the project coordinators. The information form was structured to get systematic information on:

The category of the threat, the main and side causes, the starting year, the current situation, any societal action about the threat, the ways of taking action, the groups taking action in order to prevent the threat, the state institutions and organizations related with the threat in terms of jurisdiction, the regulations and the related references (TEMA Vakfi, 2016, p.7).

The first coordinator explained the method: *“First, we made this something with closed loop. We sent the form to the TEMA representatives. We constituted a form as of let’s take and fill this.”* The coordinators determined three main threat categories in order to be classified by the volunteers:

There is water quantity threat, there is water pollution threat and there is access to water threat. We called them main categories. In water quantity threat, there are drought of streams and groundwaters, in access to water threat, other social dimensions involve, drinking water involves, dams involve because you access to stream before then they build a dam (2nd Case Coordinator 1, personal communication, June 14, 2019).

Considering the citizen science type of the project (Bonney et al, 2009), The volunteer representatives are not involved to the research design and the overall data analysis and large amount of data are gathered at national scale suiting the contributory type on the other hand, the volunteer representatives analyzed their local case as suiting the project to the collaborative type as well. The first coordinator explained the volunteer participation state in the research design:

Unfortunately, no, they did not participate to the research design, because as I said, it started pragmatically, you need to do something, you do it among your many other jobs, you should do it quickly as much as possible. Actually, how should it be in reality, we would choose particular stakeholders, talk them and ask their suggestions by saying ‘we are going to do something like this what shall we ask?’, we could not say. It is not successful in that manner, but we had an advantage, there are crowded foundation employee mass in TEMA, we consulted this to those who work at this topic in the foundation. At least, we tried to do this (2nd Case Coordinator 1, personal communication, June 14, 2019).

One of the active citizen scientists mentioned institutional restraints regarding volunteer participation: *“I did not participate. According to the foundations’ regulations, the representatives cannot do project, head office does. Head office is trying to get maximum help from local units for the success of the project”* (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

The first coordinator stated the collaborative notion of the project; *“Maybe we did not say let’s do this form together, but someone should come and enter these cases. They are free on what to write. They are free on which category they are going to put.”*

The reason of such freedom was explained as:

One of the things what I am going to try here is let's put this one, let them do what they understand because it is also a data. I did not tell or write what access to water etc. is especially, because I want to understand also what they think about access to water. I wanted them to interpret this. I wanted them to interpret drought and pollution issues. For instance, sometimes eutrophication is happening in case of water resource' drought then, he/she assumes that water is polluted. We wanted to understand what people understand there (2nd Case Coordinator 1, personal communication, June 14, 2019).

An essential notion of citizen science is non-scientists' participation in scientific research as researchers; however, the volunteers assumed that their job is filling a survey. The first coordinator stated the volunteer perception on their mission:

Language is so important. We made it as for contributing to the map from the start, so I never wrote survey form to anywhere. You only enter a point to the map, but people think this as survey insistently, they think that they are more passive. Few people really, actively perceive that the actor there is himself/herself (2nd Case Coordinator 1, personal communication, June 14, 2019).

The technologies are important actors enabled the research. The mapping technology and the online google form are intersement devices facilitated the research through their associations with the project coordinators and the citizen scientists. The first coordinator stated the associations with the technologies:

Everyone can do that because technology has become easier. As I said, you need two knowledge, latitude and longitude. You pick a point at Google Maps and it gives you coordinates by a click. You do not need extreme mapping knowledge. I do not assert that I know GIS. You process data through a database in which you put latitude and longitude on it. What we have done is that simple. When we start to do that, there was not such a thing of Google, so people's data entrance was not easy; then when it became easier, I made it myself.

The technologies' role and the dynamism in the association were emphasized:

I mentioned, when we start to this in Turkey, there was no interactive mapping platform. When there was technology which had reached a particular thing, we sit and made it, it's easiness, it's applicability, its ability to be done by someone who are experienced with it a little bit are

important criteria. Technology is so much more different now; this map stayed behind technologically; It is restraining what you want to do. It is not something to be done without technology, because otherwise its' alternative is collecting data by talking with people on the phone or by visiting them one by one. It is old type social science research. Here main actor is technology (2nd Case Coordinator 1, personal communication, June 14, 2019).

Following the first coordinator, the active citizen scientists also stated their associations with the technologies:

We made our works on internet network, therefore we took both our references and data over the internet. We incorporated the data over internet, over the database generated by head office. Hence, data was collected, concentrated at one hand in very short amount of time all in Turkey (2nd Case Citizen Scientist 1, personal communication, August 6, 2019).

“We entered these reports over computer. We entered with a special program, with an encryption. We communicated over computer. The images, the photos taken over telephone, there are methods we took from our friends who have more special knowledge technologically” (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

We are clicking, writing from there, it is appearing there itself. It is very practical. We are seeing written things there in very short amount of time too. It was a nice thin; a thing quick data entrance was able to be done. It is more practical alike because data can be entered from very points (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

The project coordinators have constructed the research method including the associations of the coordinators, the citizen scientists and the technologies in order to realize the research problem. Following process includes the enrolment state of the human and the non-human actors leading to the project outcome.

5.2.3 Enrolment

The project which has started by the end of 2015 has aimed to monitor the threats of the water resources throughout Turkey by the data entrance of 81 TEMA volunteer city representatives who have one month to provide information on the water threats in their cities. In March, the first outcome has occurred as 59 threats in 37 cities documented by 31 representatives (TEMA Vakfı, 2016, pp.7-8).

The first coordinator evaluated the low participation:

The participation is low. There are 81 representatives in each city. We thought as if one case at least comes from each city; it did not come. We started with 59 cases. Some of the 59 cases were same. Some representatives were active, entered 6 cases. Some entered one, most of them did not even make effort for this. Firstly, even these people who are a selected group already interested in environment may not be interested in it. Actually, you are doing very hard thing, there is really a few masses who are going to make an effort and you try to reach them all. It is not possible. There is no such mass of people at Turkey. Nevertheless, it is very successful (2nd Case Coordinator 1, personal communication, June 14, 2019).

The coordinators stated NGO's busy agenda and the political conflicts in Turkey as the effects in the research process. The first coordinator stated that busy environmental agenda is causing lack of interest into the map:

There are pragmatic priorities. The map is appearing in World Water Day, be updated as press release in each year then it is forgotten over year (laughs). Even in TEMA, the water map is reminded in The World Water Day because there are so many problems. It is pragmatic choice. You cannot work continuously thinking this map (2nd Case Coordinator 1, personal communication, June 14, 2019).

The second coordinator stated that the political conflicts affect collectiveness:

Something started to really go wrong from 2014. This is my perspective of course. That participatory soul started to vanish in time because producing something collectively is very hard, we have serious problems. In my opinion, the reason of growing of these problems is not doing anything collectively, therefore our only solution is collectiveness even if it is hard (2nd Case Coordinator 2, personal communication, July 10, 2019).

The active citizen scientists who are enrolled stated their associations:

I had both works and observations before on the city's water resources because of living in this city and this water resources' relatedness with my branch. While I was going from one city to another, I was monitoring nearby lakes and streams and I was following academic works made on these topics. By transferring the outcomes of our observations, and more by collecting scientific data over internet, we associated this information. We constituted and

classified the threats regarding water resources in local frontiers and we sent it to the head office. Of course, this formation and classification happened with a particular system through using the form given to us (2nd Case Citizen Scientist 1, personal communication, August 6, 2019).

TEMA informed us on the projects. They delivered what we should do in which process. We made preliminary of these. First, we discussed with The State Hydraulic Works because it is controlling all water resources at Turkey. Later on, a link was given to us to enter information we received to the system until that date. Because of open access of this system, it was expected to be made in summarized way, we entered our information to the system within the scope of this restraints. We got the reports of State Hydraulic Works, our observations and the observations of the county representatives. We asked to the experts on the things we had troubled (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

There are related projects we conducted already. For instance, we are part of environmental impact assessment report processes of these projects. We carried on counter campaigns, prompted locals on this topic in legal dimensions. We made platforms; these projects are the projects we know. The references there based on the legal decisions to a large extent or verified by many academics (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

The active citizen scientists mentioned the lack of reference and the low communication in the research process. The lack of reference was stated as a problem:

We had to add references to the list. Here our biggest problem was lack of resources we can benefit from; we can admit as references. I remember that we had a problem on putting a formal or scientific reference beyond our observations (2nd Case Citizen Scientist 1, personal communication, August 6, 2019).

Announcement of project was stated as a problem effecting the project:

Failing part was, of course first to announce this was important. Even if it is within the scope of our foundation, many of our friends maybe were not interested in adequately. Maybe did not know it, but this process is continuing with flourishing (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

The first coordinator moderated the data. Institutional restraints were stated:

When two people enter the same case, you try to combine two different perspectives as moderator, there are limits of this of course. In my opinion, two different versions should stay but we cannot do that technically. There are different things of course. Actually, I could do that, when you enter Google Form, it forms spread sheet list over internet, people could enter latitude and longitude directly, you can turn this to a map lively. It is technically possible. It can be a real citizen science without moderation, without anything they enter what they want, three version of same case can stay side by side as spots but although it does not want it, it is something TEMA endorses, there are TEMA and EU project logos on it. It should be filtered in a sort of way. There are this kind of problems. You have to put limits when you do that institutionally (2nd Case Coordinator 1, personal communication, June 14, 2019).

The coordinator has edited the data provided by the enrolled citizen scientists and the outcome has been translated into the online map with the enrolled technology.

5.2.4 Mobilization and the occurrence as an extension of science

The online map and the project report were announced in March 22, 2016 World Water Day. The report includes analysis of the cases provided by the representatives. The report declares 59 threats in which 35 water quality threats, 20 water quantity threats and 4 access to water threats are stated. The stream pollution is the most stated threat, drying of the lake stated second. The most stated reason of threat is industrial activities. The majority of threats are ranked as reversible, but irreversible or potential threats are also stated. While societal attempts about the threats are found low, local scientists and experts are stated most. The most stated counter attempt is formation of alternative solution offers (Tema Vakfi, 2016, pp.8-13). The map is stated below (Figure 5.2.3.1).

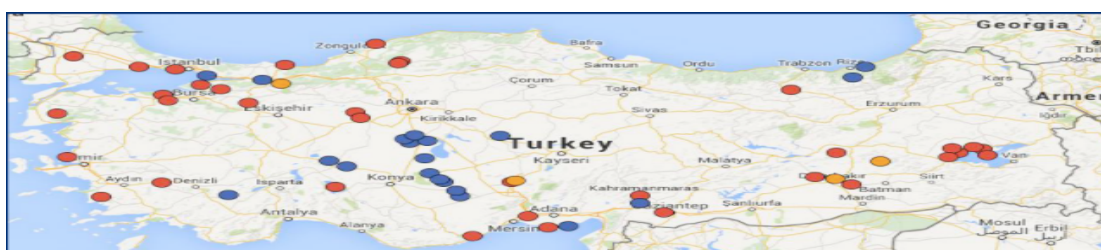


Figure 5.2.3.1 Distribution of Water Threats in Turkey (Tema Vakfi, 2016, p.8).

Red Dot: Quality Threat - Blue Dot: Quantity Threat - Yellow Dot: Access Threat

With the translation into the interactive database platform, The Map of Threats to Water Resources in Turkey has started to be open to public participation. In three years, the threats increased from 59 to 109. The third coordinator who are the current project coordinator explained the update; *“I guess now there are 109 threats by the end of August 2018, it has increased from 2016 to 2018. Actually, it is active but there is no data input since August 2018, I checked the latest”* (2nd Case Coordinator 3, personal communication, July 10, 2019). The current state of the map is continuing as an active system which is open for any association; however, it is stagnant now. The first coordinator explained the situation:

It is only a platform. It is valid for water resources too. You will go and enter this yourself. If you do not enter, the platform will not live, if you do enter, it lives. As I said, it is sleeping. No problem, it is not something its' coordinator would do, it is something about it is being embraced. I constituted the platform, more or less there is something there, people should come and enter. If we are appealing enough, if we advertise it, if people embrace it, they are entering, if they do not embrace it, they are not entering (2nd Case Coordinator 1, personal communication, June 14, 2019).

The new attempt is stated which is going to revive the water map again. One of the aims of the project was to use the water map in evidence-based policy making. In 2016, the report has emphasized the importance of realizing initiatives like EU Water Framework Directive and River Basin Management Plans. TEMA asserted its' competence to be part of the related policy making process (TEMA Vakfı, 2016, pp.14-17). Currently, the second coordinator stated the new association with the map regarding the river basin management plans:

We have included the water threats map into our European Union Participatory River Basin Management Project too which has started new in May. It will last 15 months. We are going to try to activate it again in World Water Day because the threats are continuing by increasing (2nd Case Coordinator 2, personal communication, July 10, 2019).

Consequently, The Map of Threats to Water Resources in Turkey has reached its translation by the first outcome; on the other hand, the research has been continuing as being ready to be associated with public or institutional agents. Citizen science's essentiality lies in its' such actuality.

By the various associations of the human and the non-human actors, The Map of Threats to Water Resources in Turkey has been constructed as an extension of science. The coordinators and the active citizen scientists stated the relation of the project with science. The project as science and any science of the project were stated:

You can produce science from it in two ways. One, you can say this is science itself, announcing report by revealing a data directly, besides you can produce data by generating it statistically. Plus, you can reveal another information science by making meta-analysis of it. It can turn to another data as what people framed from where, what they wrote and how they wrote (2nd Case Coordinator 1, personal communication, June 14, 2019).

The participatory science quality of the project was stated:

I see science everywhere therefore everything has a relation with everything. What we do is more a participatory science rather than puritan science. It is not something just made with technocratic perspective. I think it is very important, it is a method beyond letting the job to the expert with technocratic mind. We can say that it is an understanding of science defending primary voice of the people at the solution of problems who are primarily affected from these problems. I think it is very different and it is one of the tools of it (2nd Case Coordinator 2, personal communication, July 10, 2019).

Scientific perspective of the method and the scientific references were stated:

There is connection of the project with science. Uncovering threats of our ground waters and surface waters. First of all, naming these threats, then listing solution offers below can be said as a scientific perspective. There is a scientific part of this project, this is already the purpose of asking reference at the same time. Putting the references related with these threats, related with each water resources below, these are scientific references, there is already a scientific side of it eventually (2nd Case Citizen scientist 1, personal communication, August 6, 2019).

The scientific references which are able to be used by scientists and being an EU project were stated:

Most of the information acquiring or recording here are based on scientific measures. Of course, the measures either performed by universities or state are based on scientific foundations. So, source of the pollution of polluting water resource is analyzed by scientific

methods, therefore, it is a work quite contributing to benefitting of scientists too actually. It is not just a volunteer project, because of being a European Union project fundamentally, it has been done with scientific methods already or scientific methods have been included here as far as possible (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

Academic support in the information and the possible science committee effect were also stated:

The friends who entered information there locally, their academic support exist substantially at environmental impact assessment processes, court processes of these projects because it does not happen without it, the consultants too are academicians eventually. For us it requires to consider all the reports either positive or negative therefore the information there have an academic support at local. Plus, there is our science committee of the foundation working on water, there exists a scientific base of it (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

The scientific outputs which are generated out of the project too refer to another relation with science. “Mapping is learning” is one of those outputs which introduces the project by emphasizing raising environmental awareness and activation through learning by doing (Özbakır and Aydın, 2017). Accordingly, the project’s contribution to further scientific research was explained by the first coordinator and the active citizen scientists. The first coordinator stated the further research plan; “*I have a plan to turn it into an academic article if it may reach 150 cases one day*” (2nd Case Coordinator 1, personal communication, June 14, 2019).

The project’s outcomes were stated as any contribution to further scientific work.

There is a contribution to scientific research too of course, At least to positioning of location and bounds of the water resources considering longitudes and latitudes at Turkey too is in question. The feature of threat forming water resources, at the same time the reason of threat, also the works which are going to resolve the threat and the works of government agencies or NGOs on awareness raising or drawing societal attention to this topic, all will have contributed to someone scientifically for sure (2nd Case Citizen Scientist 1, personal communication, August 6, 2019).

The project's contribution to academicians' further work was stated:

Of course, there is, so you too are benefitting of it for an academic work now. Let's say a university professor in Diyarbakir who cannot reach such specific information on Bursa may feel something necessary to research the topic which he/she thinks less or is beyond he/she knows by benefitting from this published data (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

The project's contribution to Turkish academy by filling the gap of such works and to provide the holistic and actual situation at national scale were stated:

Of course, there is, scientists, not every university at local prone to environmental issues especially new universities. You cannot even find scientists to talk to. I have 25 year of experience, I cannot count 25 professors across to Turkey, stating a view, talking openly, organizing report on these topics. It can contribute at least to filling that gap. At least, as I said it is very important in terms of to be able to be seeing the whole country. It is not easy for an academician to do such research, he/she use data of ministry of environment, ministry of water utmost, there may not be very current at there. You cannot reach data, knowledge, there are many problems (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

On choosing CS method, the first coordinator stated to raise environmental awareness by activating people and to have an advocacy support at national scale:

This is not an academic project, this is an NGO made awareness raising project right, you create awareness here in two ways; first, you ask are there any water resource under threat around my environment, we wanted to do that in order to TEMA representatives do that, to do it as a learning activity for them. Second, people whether TEMA volunteer or not ask this question, embrace it, especially youth who have access to the internet, who are digital literate ask, are there any lake, pond here too? or there is a stream flowing at downtown I wonder what is that? They go and research, raising awareness, activation of people. It is one of the main purposes. Secondly, to turn this into an advocacy tool at national scale by revealing a picture at national scale. These are things made on the purpose of advocacy. TEMA can get this and say we have done a thing like this when they talk to policy maker, a ministry. In a sense, it is a campaign made by the eye of civil society besides being a science (2nd Case Coordinator 1, personal communication, June 14, 2019).

Considering benefits and shortfalls of the citizen science methodology, the first coordinator stated reaching local knowledge as benefit:

The data you will have not known in any way are coming, you are not aware of it in desk job, you should work very very very much in order to reach the information they gave. For instance, when it is coming to you, you say, 'Oo how nice is that, the stream flowing in the middle of a little town polluted, dried or something happened', it is the good side (2nd Case Coordinator 1, personal communication, June 14, 2019).

The low-quality data and the low participation were stated as shortfalls:

Not everyone has the same knowledge level or the same capacity; while you are doing this, you cannot make effort for increasing their capacity whether you want it or not because you do not know who the citizen scientist is. He/ She is seeing and entering it. He / She is anybody, therefore he / she may enter data in very low quality. There is an open ended thing, he / she is writing a one sentence there, he / she is saying stream dried so it's over, then I am checking why it dried I am trying to specify it, of course it is creating problems related with low quality data. Or there are things like this, he/she is coming, starting to fill the form but because he/she has trouble even with the closed ended questions, he/ she is giving up, turning out in half of it and you no longer reach that data in anytime. There is survey, the survey lasts 10 minutes while he/she wants to spare 5 minutes. He/ she is starting with an excitement, but I am asking him/her something he/she does not know, he/ she does not want to research. He/she wants to enter to the parts which he/she knows, he/she can write a wrong thing there, such as I am asking who is the responsible of this? he/she said the governor, what relevance the governor? there is relevance in any case, but who is the responsible in district level? Is the municipality or the district directorate? Is this project top-down? Who is the responsible of it? Is the Ministry of Forestry and Water Affairs doing it? Who is doing it? Wrong things are coming on this topic. He/ she is saying himself/ herself probably the municipality is dealing with this, he/she is writing the municipality in Salt Lake, perhaps it is interested in with it but I do not think so, because it is something with bigger scale, The State Hydraulic Works should be interested in with this. Not just the province representatives, everyone. As I said, the reason of not knowing might be either not to research or not knowing even though they research. Second refers to bigger structural problem, the problem of not open data, the other refers laziness.

Your citizen scientists might be lazy. Unfortunately, people in Turkey are not doing everything perfect, there are those who do very good and those who do very bad. You cannot distinguish, you cannot make such filter (2nd Case Coordinator 1, personal communication, June 14, 2019).

The active citizen scientists too stated various benefits and shortfalls of citizen science. Disseminating science to base, applying scientific thinking, increasing environmental stewardship and awareness at national scale were stated as benefits:

Now, its strong side is going down of scientific knowledge and to make research to the level of civilian citizen. Spreading of research to base is a strong part of it. I think it is extremely important too in terms of spreading of science to the base by citizens. At the same time, citizen's bringing scientific perspective to cases; afterwards, thinking scientifically, increasing his/her curiosity towards environment or nature and questioning of cases and increasing ability to take action again by the result of it, feeling himself/herself responsible in state of the case going wrong going bad, surely, there is very big benefit in terms of awareness as country, nation (2nd Case Citizen Scientist 2, personal communication, August 6, 2019).

Raising awareness and the project's local impacts were stated as benefit:

Raising awareness, this is the most important strong side. The purpose is already raising societal awareness therefore we can say this as the first strong side. There are strong sides the project provides, as local public are adopting the issue and local administrators are being more careful while making their plans (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

The project's media news and the mobility of the project were stated as benefit:

There are many gaps in the map, when they are completed, it will become a very strong map. The press is making news by taking from it time to time, such as Turkey's environment situation report. It is not just about hydroelectric power plant projects, things created by improper use of water too, its improper use in agriculture, there are ground water, salinity, acidification, nitrate pollution issues. It is a living thing; it can be improved by contributing continuously on the vital topic like water. We believe that the project is going to be much stronger and more effective (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

Considering the shortfalls, citizens' risk to be mistaken in information pollution was stated; on the other hand, it was evaluated as to be overcome gradually:

Now accessing information has become quite easier than past. Everyone is accessing every kind of knowledge by the cell phone on their hands or the computer on their hands, but the problem is information pollution, whether this acquired knowledge true or wrong, we are very often seeing this especially in the social media, so everybody else too can take an information which shared by someone maybe as wrong intentionally and use it as if it was true. This brings information pollution and social segregation in result of it. I suppose participating of citizen too in the work, monitoring on his/her own terms, getting support from scientists too or conducting it in collaboration with scientists too will bring also them the authority or the ability of distinguishing which information is true or evaluating by intellectualizing within this kind of projects or related with citizen science. So, an intellectual state may develop in time maybe in this situation on whether an information is scientific or not scientific, true or not (2nd Case Citizen Scientist 1, personal communication, August 6, 2019).

The abstention of volunteers in terms of taking action about environmental problems was also stated as shortfall:

When we look at the weak sides, I think that politics is very effective. Political decisions are interrupting the ability to take action. When many people or group take action, the power frightens them. So, when its time, they abstain because of the negative instances, majority of people can act like not a thing should happen to me. It is possible to indicate likely unsuccessful, weak parts of the project in this way (2nd Case Citizen Scientist 2, personal communication, August 7, 2019).

Finally, the limited amount of citizen scientists and the lack of communication for further data entrance were stated as shortfalls:

In the end this is one thing, we are the ones what we call public, we are more sensitive volunteers living in this public. We have a side providing relation of public with some stakeholders and pioneering public participation to decision making processes. We do not see ourselves apart from public, one of us is teacher, one of us is engineer there is village imam too or shop keepers on behalf of responsible representatives. Weak part of it is that the data entrance can be accelerated by a little bit better advertisement. It is requiring an effort in order

to be updated. People are not saying I should enter that data suddenly. It should be kept warm. When that heat vanishes, data entrance is slowing; that can be, but the continuity of data entrance contributes vitality and actuality (2nd Case Citizen Scientist 3, personal communication, August 26, 2019).

The findings can be summarized as follows: The Map of Threats to Water Resources in Turkey has been constructed as an extension of science by the associations of the human and the non-human actors. The actors had various features generating the associations of the project. The water is an essential actor which urges the other actors to conduct a research about its harmful associations such as its improper use in agriculture, in industry or in hydroelectric power plants revealing quantity, quality and access threats on its limited entity risking a sustainable future. The technologies including mapping technology, Google form, computers and the internet are other actors enabling the other actors' data collection, data analysis and open access to the project.

Considering the human actors, the coordinator had pragmatic motivations in case of a theme and a budget expected to be realized as a project. Env-net network was motivated to improve evidence base environmental policy making in Turkey. The TEMA representatives and the other volunteers are the citizen scientists of the project who were described by the coordinator as a certain environmentalist group who primarily follow TEMA. The citizen scientists who contributed most to the project were high educated profiles who have motivations ranging from having the representative mission, having personal interest and sensibility to environment, having a profession related with environment and conducting prior struggles about environmental problems. The human and the non-human actors have associated with each other through the four moments of translation constructing the research project.

In problematization, the first coordinator who had previous similar project experience has associated with Env-net policy making initiative which has provided the start of the project as an EU project having a theme and a budget. The first coordinator and another colleague have constructed the research problem as to monitor the water threats to water resources in Turkey by the research of TEMA city representatives who were expected to learn the water threats around them by doing research. Later on, the research problem has extended as to monitor the water threats

on the water resources in Turkey by the research of public who were expected to increase their environmental awareness and to take action about the water threats around them. To learn local information regarding water resources and to use the project as TEMA's advocacy tool in Turkey's environmental policy are other aspects of the research problem.

In intersement, the first coordinator has constructed the method as collecting the water threat situations of each city's water resources provided by the 81 city representatives through filling an informing form in a closed system. The coordinator has determined the three threat categories as water quantity, water quality and access to water threat. By filling the form, the volunteer representatives were expected to state the threat's category, reasons, any counter action, the related institutions etc. with the references. Considering Bonney et al. (2009) typology, the project suits to the contributory type because the representatives did not participate to the research design and the final data analysis and the large amount of data were collected at national scale; whereas, the project also suits to collaborative type because the representatives analyzed their local cases. The first coordinator stated that the representatives have interpreted the method as filling a survey passively instead of researching a case actively. The mapping technology, the google form, the computers and the internet refer to intersement devices which were stated as facilitated the research steps and open access of the project.

In enrolment, the first outcome has occurred as only 59 threats in 37 cities provided by less than half of the representatives following the first research process (Tema Vakfi, 2016, pp.7-8). The NGO's busy working schedule, the political state of the country, the lack of communication and the lack of references were stated as effects associating with the research process. The active citizen scientists have enrolled to their mission in varied ways from collecting scientific data over the internet, using prior work and / or observations, using institutional reports to getting help from the experts. The project was not happened as it was aimed due to low participation and various associations were stated in the research process; on the other hand, the enrolled actors have provided the data by associating with the enrolled technologies, the first coordinator has edited and analyzed the data and the data has been transformed into map leading the final translation step.

In mobilization, the situation of the water threats in Turkey first was translated into the data, later on, into the spots in the map. The report and the map indicating the first outcome were announced in 22 March 2016, The World Water Day. With the developments of mapping technology, the first coordinator has transformed the project into a mobile database which has been active and open to public participation. Considering the current situation of the project, the threats doubled to 109 in two years; however, no data entrance stated since August 2018. The project's situation was stated stagnant, but it is to be activated in case of new associations such as the TEMA's new EU project on the river basin management plans planning to activate the map again.

Following the all translation steps including the associations of the human and the non-human actors, The Map of Threats to Water Resources in Turkey has been constructed as an extension of science. The coordinators and the active citizen scientists stated the relations of the project with science. The project was stated as science by generating data directly via a report. It was described as a participatory science empowering non-experts seeking to solve the problems they encountered. Describing the water threats and listing solution offers were considered scientific. Using the scientific references was emphasized. Being an EU project was emphasized regarding its scientific quality. The scientific output and the future article plan were stated. It was stated that further scientific works can be generated out of the project. Filling the gap in academy and revealing a current situation at national scale is stated.

The reason of using citizen science method was explained as raising participants' environmental awareness and activation about the water threats around them and revealing the water threats at national scale by using it in TEMA's environmental advocacy. Considering the benefits and the shortfalls of the citizen science method, the first coordinator stated that learning the local information on the water threats refers to benefit whereas the low data quality and the low participation refer to shortfalls. Disseminating science to public, increasing scientific thinking, increasing environmental awareness, increasing environmental stewardship, improving local participation, improving local policy making, being used by media and the project's mobility were appeared as benefits; on the other hand, the danger of being mistaken in information pollution, volunteers' abstention, the limited volunteers and the communication problems were appeared as shortfalls by the active citizen scientists.

5.3 The Construction of The National Jellyfish and Gelatinous Organisms Watch Program

Jellyfishes are one of the oldest species of earth's biodiversity. Sustainable environment depends on keeping the balance of biodiversity in which species have associated with each other in various ways. Increased amount of Jellyfish population which is called bloom have heightened in the Mediterranean since the late 1970's and in the Black Sea due to climate change related higher sea water temperature, water pollution and overfishing. Overfishing causes decrease of predator fish which balances the amount of the Jellyfish. The Jellyfish increase is associated with the fish decrease as well because some Jellyfish eat egg, larvae or food of some fish types. By being a predator to fish and sticking to fishnets, Jellyfish harms fishing. By occluding channels of power plants, it harms energy supply. By sticking and stinging to swimmers, it creates a public health problem. By increasing as bloom, it harms tourism. Following have been emphasized Jellyfish' increase's ecological, economic and health problems, the experts have declared that needed The National Jellyfish and Gelatinous Organisms Watch program has started in order to learn the causes of the Jellyfish epidemic in Turkey's coastal waters (Öztürk et.al, 2018, pp.1-4).

5.3.1 Problematization

The National Jellyfish and Gelatinous Organisms Watch Program shortly called What If It Stings has been conducted by The Turkish Marine Research Foundation (TUDAV) since 2014. The project is accordant with The Mediterranean Science Commission's (CIESM) JellyWatch Program which monitors the distribution and frequency of Jellyfish blooms at whole of the Mediterranean and the Black Sea region (CIESM, n.d.). The Sociotechnical changes have associated with these regions. Turkey as part of Eastern Mediterranean Basin has been having problems by the newcomer Lessepsian types which have been coming from The Suez Canal (TUDAV, 2014). The Jellyfish stings are one of the main problems in case of the contact with the toxic Jellyfish types. The sting happens due to triggered jellyfish cells' toxic organelle cnidocyte throwing instantly its toxic tubule to the associated organism (Tezcan, n.d.). When jellyfish's survival mechanism associates with swimmers, fishers or divers, it creates a public health problem that should be taken into account.

The main project coordinator who has initiated and has been conducting the project stated why the project has realized:

Excessive amount of Jellyfish has started to come to Turkey due to climate change. These are new Jellyfish coming from The Red Sea and these are burner, therefore these should be known. Very much foreign Jellyfish have started to come, when people too have started to complain too much, we said let's plan for these to be recognized and we said let's put it on human, we said what if it stings, who it is going to sting, it is going to sting human, in that case it draws attention. How it is going to sting, it is going to sting by touching, it is going to sting your eyes, your leg, your mouth, your mother, your child, your elderly etc. that's why we have developed what if it stings in this way (3rd Case Coordinator 1, personal communication, August 5, 2019).

In result of the associations of the human and the non-human actors, The National Jellyfish and Gelatinous Organisms Watch Program's research problem has been constructed as to monitor distribution and frequency of Jellyfish and Jellyfish blooms at national scale in order to scientifically understand the Jellyfish increase and its harmful impacts, and to draw the attention of the policy makers on this phenomenon (TUDAV, n.d.). The project method has been constructed accordingly.

5.3.2 Interessement

In the project method, the coordinators have prepared an online informing form by expecting information on the Jellyfish's name, seen location, seen situation, count per square meter, how it is seen, the observation date, citizen scientists' name surname, e-mail and phone number with the photo or the video of the monitored Jellyfish. Seen location, citizen scientists' name, surname and e-mail information especially stated as required (TUDAV, n.d.). The coordinators have prepared also a poster including image, name, size and toxicity state of the fourteen Jellyfish types and handed out throughout Turkey for facilitating the citizen scientists' observation. The coordinator stated the data collection briefly; *"The thing you should do is to inform a jellyfish you have seen to The Turkish Marine Research Foundation either by e-mail or phone"* (3rd Case, Coordinator 1, personal communication, August 5, 2019). Considering citizen science typology, the project is in conformity with Bonney et al.'s (2009) contributory type because of the assignment of collecting data at national scale by the citizen scientists who are not participated in the other research phases.

The collected data are analyzed by the scientifically expert coordinators. The coordinator stated the three categories of the data analysis:

If you send the photo, we are analyzing, and we are saying that this is toxic or not. First, Category A: Is it toxic or not?, Category B: It is not toxic for you but it sticks to fishnets and gives damage to fishers, Category C: It is not toxic but this it is important for biodiversity so it can damage natural balance, it does not have to be people oriented. There are three categories: Category A: Is human contacting it or not contacting it, if it contacts, does it make a thing to Hilal? B: Is there any harm of it to fishers? C: Is there any harm of it to biodiversity, to system? Is it not? So, we are looking these three things (3rd Case Coordinator 1, personal communication, August 5, 2019).

The technological actors were stated in the method. The coordinator emphasized the smart phones for data collection and the developing photography technology for the identification of Jellyfish types:

Technology, of course we are benefitting from technology. It is not possible to do project without the smart phones; how you are going to send it to me. You cannot distinguish the types if it was not the improvement on photography technology. Now there are such sensitive photo cameras that are shooting every detail (3rd Case Coordinator 1, personal communication, August 5, 2019).

The coordinators have designed the method in which they expected to collect Jellyfish data throughout Turkey provided by the citizen scientists who are everyone required to shoot the monitored Jellyfish and to inform the experts on its name, location, situation ex cetera. Later on, the coordinators have planned the data analysis by focusing Jellyfish's harm to people, fishers and biodiversity. The photo cameras shooting the Jellyfish in detailed, the posters helping the citizen scientists to recognize the jellyfish types, the online informing form providing to collect structured information on the monitored jellyfish and the smart phones enabling the citizen scientists to send their observation to the coordinators are intersement devices which have enabled the data collection and the later data analysis. The method has been constructed in order to actualize the research problem; on the other hand, the project's success depended on to the enrolment of the actors to their assigned role in the method; accordingly, the next phase includes the first outcome of the project.

5.3.3 Enrolment

The method has been constructed, the interessement devices have been applied; however, the coordinator stated the low participation of the citizen scientists considering the first outcome:

Its weak because to participate in a thing at Turkey is not something state directed. We do not have help to a project, volunteering basis, in people, in our schools, in our education system. It is understood two things from the volunteering; either it is going to be The Red Crescent in Turkey, it is going to be The Green Crescent, or it is going to be The Disaster and Emergency Management Presidency; beyond these is not seen as volunteering here. So, everything is volunteering, Volunteering education should be given in Turkey; should be given better. So, volunteering education is not to give blood to The Red Crescent in Turkey or to do a thing in The Green Crescent. The volunteering education at the same time is to raise people who are going to care the country's problems, to mobilize them, to activate them (3rd Case Coordinator 1, personal communication, August 5, 2019).

Considering any association affecting the research process, the coordinator emphasized the importance of expertise:

There is no an affecting element, what is going to affect? Jellyfish cannot direct the project; we direct the project. To define Jellyfish types is the problem. There is expert need on this topic. Have I made myself clear? This is a job requiring specialization (3rd Case Coordinator 1, personal communication, August 5, 2019).

In order to actualize the research problem which is to scientifically understand Turkey's Jellyfish epidemic and its harmful impacts and to draw attention of policy making on the phenomenon, the coordinators have constructed the project method which includes the data collection of public who were expected to send their observations to the project coordinators by associating with the interessement devices and the data analysis of the expert coordinators of these observations. The first outcome has revealed that there is low participation of the citizen scientists in terms of enrolling to their mission. The required expertise for data analysis was emphasized. By the associations of the enrolled citizen scientists and the enabling technologies, a first outcome has been reached and the coordinators have translated the Turkey's Jellyfish epidemic phenomenon in mobilization.

5.3.4 Mobilization and the occurrence as an extension of science

Following the associations of the citizen scientists, the technologies and the coordinators, the situation of Jellyfish epidemic has been translated first into the data then into the points in the map. The project website including the first outcome, the project call, the project information and the first aid information has been constructed in 2014 (yayakarsa.org). Besides the project website, the coordinators have constituted the social media pages and the hashtags of the project in which they disseminate the project to the public, inform public on the Jellyfish types and share the citizen scientists' observations by thanking them for their contribution (@yayakarsa.tudav; @yayakarsa; @YaYakarsa).

The project still has been continuing to collect data for understanding and acting about the Jellyfish increase in Turkey. The current state of the monitored jellyfish indicated in the project website is stated below (Figure 5.3.4.1).



Figure 5.3.4.1 The Monitored Jellyfish in Turkey's Coastal Waters (TUDAV, 2020).

By the associations of the alarming Jellyfish increase, the mobilized coordinators, the participated citizen scientists and the enabling technologies, The National Jellyfish and Gelatinous Organisms Watch Program has been constructed as an extension of science. The coordinator stated the relation of the project with science:

Without science, the project does not happen. It is very related with science. You should know which Jellyfish, which species are. We use science for that. This project contributes science because we are learning new things. What comes from where, which species from where, at how many meters, at what depth, how many, so it is important (3rd Case Coordinator 1, personal communication, August 5, 2019).

Considering the project's contribution to the scientific works, the coordinator stated that *"It is important too, there is; because as I said, many people are learning a new thing"* (3rd Case Coordinator 1, personal communication, August 5, 2019). The Turkish Marine Research Foundation has published a scientific book introducing the Jellyfish species in Turkey's coastal waters, in which the ongoing project has been mentioned (Öztürk et. al, 2018).

When the reason of using citizen science method asked, the coordinator emphasized collecting data at large scale in a zero-cost way:

Because There is a very large terrain of Turkey. We cannot monitor the Jellyfish at İskenderun from İstanbul, or the one at Rize or at Sinop or at Kuşadası. So, people should know this; we should get support and help from people. This should be zero cost. You write a Jellyfish you saw from WhatsApp; Is this Jellyfish toxic or not, Is it one, two, three, five, its number, population, species, which species, these should be known; so that we cannot accommodate soldier, policeman, watcher, student for Jellyfish throughout Turkey, we wanted to ask help from people and to use citizen science in that sense (3rd Case Coordinator 1, personal communication, August 5, 2019).

Considering the benefits and the shortfalls of the citizen science method, the coordinator stated some citizen scientists' effort as benefit; *"Certain sensitive people are trying to do something in certain regions."* However, low participation was stated as shortfall; *"Its weak part at Turkey is people are not participating; to activate people is hard"* (3rd Case Coordinator 1, personal communication, August 5, 2019).

In order to summarize the findings, The National Jellyfish and Gelatinous Organisms Watch Program has been constructed as an extension of science through the associations of human and non-human actors. The various sociotechnical associations, such as gathering of climate change, overfishing and new routes by The Suez Canal have associated with alarming increase of Jellyfish in Turkey. Due to the broken environmental balance, Jellyfish's acts for survival have associated with humans, fishers and biodiversity resulted with harm. By associating with the problems in the environment, the Jellyfishes are actors motivating the coordinators to conduct a scientific research about its harmful increase in Turkey. Other non-human actors, the smart phones, the photo cameras and the mapping technology have facilitated the research by associating with the human actors. The human and the non-human actors have associated with each other in four steps of translation constructing the project.

In problematization, considering the many public complaints about the newcomer burner Jellyfish in Turkey's coastal waters, the coordinators have constructed the research problem as to monitor Jellyfish increase scientifically and to direct the related policy making. In Interesement, the coordinators have constructed the method in order to realize the research problem. The method has been designed as data collection of public who associate with the interesement devices by taking Jellyfish photo, filling the online informing form and sending it via phone or e-mail to the coordinators and data analysis of expert coordinators who consider the Jellyfish's effect to the people, to the fishery and to the biodiversity. In enrolment, the first outcome has emerged by the low participation of the citizen scientists. The coordinator emphasized the importance of expertise for the research. In result of the associations of the coordinators and the enrolled citizen scientists and technologies, the first outcome has been constructed regarding the research problem.

In mobilization and the occurrence of an extension of science, the situation of Jellyfish increase was translated into a map reflected in the project website. The coordinators used social media for disseminating the research, informing public and communicating with the citizen scientists. The research has still been continuing to collect data for realizing the analysis and completing the research problem eventually. The project has been constructed as an extension of science which the coordinator stated the project's direct relation with science in terms of benefitting from science and contributing science by generating new knowledge. The contribution of the project

to the scientific works was also stated in terms of learning new knowledge. The coordinators have produced a scientific output related with the project (Öztürk et al, 2018). The coordinator emphasized collecting data at national scale by eliminating the costs as the reason of choosing the citizen science method for the project. Regarding the benefits and the shortfalls of the citizen science method, the coordinator stated the certain efforts of some citizen scientists as benefit however, the low participation of the citizen scientists and the hardship of mobilizing volunteers were stated as shortfalls.





6.DISCUSSION

Following the insights, which have been gained by Latour (2005) and Callon (1984), the three environmental citizen science projects have been described without bringing any pre-constrained explanatory framework, social vs. nature or macro vs. micro divide by indicating the dynamic associations among human and non-human actors constructing the projects as an extension of science. Considering the main themes of citizen science literature, the three projects share particular features which are going to be discussed with the literature findings. Subsequent to an ANT analysis on the three projects by also considering the main themes of citizen science literature, the discussion highlights how the projects have been constructed as an extension of science by discussing the projects' prominent sociotechnical associations with the literature.

The three projects have constructed their networks regarding environmental concerns. Breeding birds, water resources and jellyfishes in Turkey have been transformed to the research subjects as non-human actors indicating the environmental situations through their associations with the other actors. Institutional associations are apparent in the networks in which while the three projects have been conducted via non-governmental institutions, the projects also have methodological and / or financial relations with international research or policy making institutions. The institutional associations indicate that non-governmental organizations which gather experts and volunteers together about sociotechnical problems have great potential to conduct citizen science research affecting evidence-based policy making; also, international institutions are important in citizen science projects regarding methodology and / or financing. Importance of existing network is another feature in the three projects for sustaining expert or volunteer support. Following to the associations in problematization, the project coordinators have constructed their research problems as to monitor the environmental situation by the data entrance of the volunteers for various reasons including to direct policy making.

Citizen scientists of the three projects are birdwatchers, TEMA city representatives and public in Turkey who are expected to participate to the projects. A shared characteristic of citizen scientist profile has been stated as being a small amount of population who are divided in groups by the first coordinators of the 1st and the 2nd projects. Citizen scientist term were not embraced by the respondents who used identities such as birdwatcher or being TEMA volunteer which refer that citizen scientist terminology has not been constructed yet among the participants. Considering the active citizen scientists' profile, the six respondents who are in average middle aged, minimum license educated men including two academicians and a PhD student indicate that although conceptualization of citizen science has been constructed as non-scientists' participation to scientific research, those who have science background might appear as efficient citizen scientists in the research. The 1st project and the 2nd projects' active citizen scientists' motivations have been asked considering what motivated them to associate with the other actors in the projects.

In terms of motivations to participate to the projects, the active citizen scientist respondents were sharing similar motivations with Kragh's (2016) volunteer motivation study by having both autonomous motivations such as personal interest and enjoying being in nature and altruistic motivations such as contributing science and nature conservation; on the other hand, trusting work of the coordinator in the 1st project; and, having an NGO mission, having related profession and being experienced on project topic in the 2nd project have also been stated as case specific motives. Considering the coordinators motivations, altruistic and autonomous motives in the 1st project and the case specific motives as trusting the first coordinator's work in the 1st project and recognition of new comer Jellyfish types in the 3rd project have been stated with the pragmatic motive as to actualize the project in case of calling topic and funding in the 2nd project. The case specific motive, trusting the work of known coordinator in the 1st project indicates that project coordinator's credibility and network might be important for active citizen scientists and other coordinators' project participation; also, to do the mission as NGO volunteer representative and having related professional, educational or advocacy experience motives of the 2nd project's active citizen scientists indicate that active citizen scientists might be motivated to participate a citizen science project based on their mission and related background.

The project coordinators have constructed research method by associating with the citizen scientists and the technologies in order to realize research problem in intersement. Collecting nation-wide data by the citizen scientists have been aimed who have not participated to the research design and the final data analysis. In the 2nd project, constraining NGO regulations have been stated regarding more participatory project design; therefore, updating NGO regulations on project conduct would be an option for NGOs in order to suit participatory notion of citizen science. Considering citizen science type, while the 1st and the 3rd projects suit contributory type, the second project suits collaborative type too (Bonney et al, 2009). In the three projects, the citizen scientists have been assigned to fill an information form and to send it to the coordinators. Despite of citizen science's novelty considering citizen scientists as researchers in scientific research, the citizen scientists of the 2nd project have considered their role as filling a survey like a respondent instead of being an active researcher according to the first coordinator which indicates that citizen scientists might interpret filling an information form task as responding a survey like an old type social science research.

The technologies including geographic information system (GIS) technologies, information forms, online database apps, smart phone cameras etc. have been used as intersement devices and these technologies are actors by enabling the data collection and the data analysis of the research processes. As consistent with Kocaman et al. (2017) who have emphasized the importance of geospatial technologies in citizen science, the project coordinators who have associated with the GIS technologies emphasized the feasibility of using these technologies in generating their data processing design. The ongoing developments in GIS have been emphasized which as well have transformed the 2nd project from closed to interactive system. The qualified photography technology enabling the species identification has been stated in the 3rd project. While GPS and eBird have been considered as enabled wider access in the 1st project, pursuing paper-based technology has also been stated as consistent with Geoghegan et al.'s (2016) remark. The technology outcome indicates that technologies tend to facilitate the research processes, tracking the technological development is an important factor to conduct qualified citizen science research and those who do not or cannot use technology might be a consideration for the project coordinators.

Geoghegan et al.'s (2016) another remark, importance of communication and feedback has been considered by the 1st and the 3rd projects' project coordinators through using social media in their associations with the citizen scientists. The research methods were constructed by expecting the actors were going to suit the assigned roles. The outcomes appeared in enrolment.

In all the three projects, the research processes have encountered with low participation of the citizen scientists. Considering the associations affecting the research process, political conflicts in Turkey is a common response which have been associated with not foreign birdwatcher attendance in the 1st project and lack of participation in the 2nd project. Other stated associations are volunteer behaviors, volunteers' busyness, grouping period, personal conflicts with the first coordinator and hardship of periodic work in the 1st project; whereas, NGO's busyness in the 2nd project; on the other hand, while no association have been stated in the 3rd project, importance of expertise has been emphasized. In terms of the active citizen scientists' associations in the research process, locals' reactions, hardship of the periodic work and security intervention have been stated in the 1st project; whereas, lack of references and lack of communication have been stated in the 2nd project. The associations affecting the research processes indicate that scientific researches might not have linear processes; instead, various sociotechnical developments from political conflicts, personal issues to communication problems may affect research processes.

Various strategies have been applied for project improving in the 1st project including managing personal conflicts, conducting meetings, introducing the project to the policy makers, trainings volunteers and facilitating the method as consistent with the strategies stated by Kosmala et al. (2016) and incorporating of the earlier breeding bird data to the project. The three projects have not been processed as it was ideally expected; on the other hand, following the associations of the enrolled citizen scientists and technologies, the coordinators have edited the data and the outcomes have been reached resulting with the mobilizations.

The Environmental situations of breeding birds, water resources and Jellyfish in Turkey have been translated into the points in the maps and shared in the project websites. The three projects are consistent with the open science principle of citizen science by having project websites (ECSA, 2015). The 1st project and the 2nd project have shared their project reports (Türkiye Üreyen Kuş Atlası, 2019; TEMA Vakfı,

2016) in the websites. Considering the current phases of the projects, the 1st project has been terminated with the further atlas project plans; the 2nd project has been designed as an online active platform which has been continuing by being open to further data input; and, the 3rd project has been continuing to collect data in order to actualize its data analysis and to finalize its research problem.

Following all associations of the human and non-human actors, the three projects have been constructed as an extension of science. Considering relations of the projects with science, the three projects are consistent with the ten principles of citizen science (ECSA, 2015) by generating new knowledge through contribution of non-scientists, by having science outcome through indicating environmental situations systematically as suitable for evidence-based policy making and by producing scientific outputs out of the projects. As consistent with the minimum scientific standards of citizen science by Heigl et al. (2019), the three projects have set research problems generating new knowledge and have applied scientific methods consisting of systematic designs, scientific references and editing and analyses by experts. It has been learned from the coordinators and the active citizen scientists that the projects have scientific state by generating knowledge through systematic methods, by producing scientific outputs as the project reports and / or the publications, by benefitting from science in the research phases and by having ability to influence further scientific researches. Considering the coordinator statements on the reason of choosing citizen science method, to realize research at national scale by the contributions of volunteers is a shared reason in the three projects.

In terms of the coordinator statements on benefits and shortfalls of citizen science after their project experience, collecting vast actual data by overcoming costs through mobile birdwatcher mass who use online platforms at large scale in the 1st project, learning local knowledge in the 2nd project and the few volunteers' given efforts in the 3rd project have been stated as benefits; on the other hand, while low participation is a shared shortfall stated in all the projects, volunteer management too stated as shortfall in the 1st project. Following low participation, low quality data is another shared shortfall stated in the 1st and the 2nd project. Considering benefits and shortfalls of citizen science by the active citizen scientists after their project experience, producing data systematically at large scale and starting awareness and bureaucracy support in the 1st project and spreading science to the bottom,

non-scientists' scientific thinking, improving environmental stewardship, raising environmental awareness as nation, as well as local developments, media releases and mobility of the project in the 2nd project have been stated as benefits; on the other hand, low participation and fieldwork interventions in the 1st project and infollution, volunteers' avoidance, few volunteering and low communication in the 2nd project have been stated as shortfalls.

The stated benefits indicate that generating large amount of data by the contribution of people at extensive scale appears as one of the main benefits as consistent with the literature (Shirk and Bonney, 2018). Learning local knowledge which might be hard to learn can be considered by the project coordinators depend on the project context. Eliminating project costs appears as another benefit in terms of the coordinators. Improvement of environmental awareness, increasing environmental stewardship or local policy making benefits should be assessed with further research. Importance of media also appears which connect citizen science projects with public on dissemination of project knowledge, volunteer call etc. Having mobile project system appears as a benefit for a citizen science project in terms of being open to updates.

Contrary to the benefits, the stated shortfalls indicate that although few volunteers' participation appreciated, there is low participation of citizen scientists in all the three projects even in case of the relatively easy task in the 3rd project. Giving incentives to volunteers considering the project circumstances appears as an option for increasing participation. Not only low participation but also managing participated volunteers stated as another shortfall which should be considered by the project coordinators. Low quality data stated in the 1st and the 2nd project were overcome by the expert edit; and, designing volunteers' task adequately and training volunteers on how to conduct scientific research appear as important requirements for increasing data quality. Volunteers' possibility of being mistaken in information pollution which is another stated shortfall might be overcome by such trainings. Any fieldwork interruptions should be considered in conducting citizen science projects having fieldwork. There should be further assessments about any possibility of volunteer abstention. Finally, importance of communication which stated as shortfall in the 2nd project appears for project achievement.

7. CONCLUSION

In conclusion, citizen science in other words public participation in scientific research has been developing day by day as an extension of science in intersections of academy, policy making and civil society as a scientific method and an emerging discipline. The literature review is highlighted how citizen science has been constructed by considering main themes from principles, research types, motivations to benefits and shortfalls of citizen science. A gap is found regarding detailed description of how citizen science has been constructed as an extension of science; therefore, an actor network theory research is aimed on the three prominent large scale environmental monitoring projects in Turkey which are The Turkish Breeding Bird Atlas (1st project), The Map of Threats to Water Resources in Turkey (2nd project) and The National Jellyfish and Gelatinous Organisms Watch Program (3rd project) in order to understand how the three projects have been constructed as an extension of science. Semi structured interviews are made with the coordinators of the three projects and the active citizen scientists of the 1st and the 2nd projects. Following the analysis of the interviews and the projects' documents, each project is described and occurred patterns are discussed with the citizen science literature. The thesis contributes to the insights on large scale environmental citizen science research.

The shared actor networks of the three projects have demonstrated that in case of the associations creating ecological, health or economic problems, the breeding birds, the water resources and the Jellyfishes in Turkey have become research subjects which have transformed the project coordinators who have set their research problems as to monitor the environmental situation at national scale and to inform the related policy makers. Institutions are prominent in the projects' network through the NGOs in project conduct and the international research and/ or policy making institutions in funding and / or methodology relation. Impact of the existing networks in the associations is another prominent aspect regarding the contributions to the projects.

The birdwatchers in the 1st project, the TEMA city representatives in the 2nd project and the public throughout Turkey's coastal waters in the 3rd project have been assigned as citizen scientists by the project coordinators. The project coordinators have made the research designs in which the citizen scientists have not participated to the research design and the overall data analysis. The citizen scientists have been expected to send data by filling the information forms through associating with the various technologies which have mainly facilitated the data collection and the data analysis. The GIS technology has appeared as essential actor in case of data processing and demonstration of the projects. The project coordinators expected the actors were going to suit their assigned roles in order to realize research problem.

The first outcomes have realized with the low participation of the citizen scientists. Various sociotechnical associations have affected research processes indicating not linear research formations. Following the associations of the enrolled citizen scientists and technologies, the project coordinators have edited the data and the environmental situations of breeding birds, water resources and jellyfishes in Turkey have been translated into the maps disseminated through the project websites. While the 1st project has been terminated with the further project plans, the 2nd project has a mobile database by being active for public data input and the 3rd project still has been continuing to collect data for achieving the research problem.

Following the associations of the human and non-human actors in the research processes, the projects have been constructed as an extension of science. The projects have related with science in accordance with the citizen science principles by generating new knowledge with the contributions of the non-scientists through scientific methods including applying systematic design, benefitting from scientific references as well as editing and analysis by experts. The scientific outputs which have been produced out of the projects refer to another association of the projects with science. The projects have got assistance from science in the research processes and contribute to science by generating new knowledge through scientific methods and by influencing any further scientific research. A shared reason of using citizen science method is to be able to do nation-wide monitoring by the contributions of the volunteers who have been throughout Turkey. Low participation has appeared as a shared shortfall out of the three projects.

Citizen science phenomenon as an extension of science has been described by the constructions of the three projects in which non-scientists have participated in scientific research as citizen scientists instead of respondents to or receivers of scientific inquiry. Generating new knowledge on a large-scale phenomenon by the contributions of the citizen scientists through scientific methods including application of systematic design, use of scientific references, editing and analysis by the experts as well as the scientific outputs have connected the projects with science. Besides the various stated benefits of the projects indicating the importance of citizen science, the projects have several shortfalls too revealing necessity of improvements; accordingly, realizing science communication of citizen science and improvement of given efforts by the acquired experiences out of these projects are important considerations for citizen science collaborators.

Considering the actor networks of the three projects in terms of science communication, the projects do not have informal science education aim; on the other hand, the side gains out of the projects can be assessed with further research. Regarding public engagement with science, the statements on the profile of the citizen scientists and the low participation of the citizen scientists to the projects indicate that there is low public engagement in the three projects. Public engagement with science prominent with dialogue model requires collaboration of experts, members of public and policy makers with regard to sociotechnical problems and the associations of the three projects indicate that there should be further efforts in this collaboration.

The thesis has described the research formation process of the prominent citizen science type, large scale environmental monitoring research; on the other hand, description of the other citizen science types would enrich to understanding of the citizen science concept especially co-created citizen science projects in which non-scientists develop scientific research on their curiosity or concerns or collaborate with scientists by participating to all phases of research process. Another further research would be on volunteer motivations for citizen science, ethics of citizen science, scientific quality of citizen science projects, assessment of citizen scientists' environmental stewardship or understanding of science after their project experience as well as interaction among citizen science and policy making.



REFERENCES

- Anbaroğlu, B., Kocaman, S., Uğurlu, A., and Demir, N.** (2017). Sivil Bilim: Mobil Çağda Bilimsel Süreçlerin Gelişimine Yeni Bir Yaklaşım. In *Academic Informatics Conference*, Turkey. Url <https://ab.org.tr/ab17/bildiri/241.pdf>
- Auerbach, J., Barthelmess, E. L., Cavalier, D., Cooper, C. B., Fenyk, H., Haklay, M., ... Shanley, L.** (2019). The problem with delineating narrow criteria for citizen science. *Proceedings of the National Academy of Sciences*, 116(31), 15336–15337. doi: <https://doi.org/10.1073/pnas.1909278116>
- Atlasintarihcesi.** (n.d.). Retrieved from <http://kustr.org/kusatlası/hakkında/atlasın-tarihcesi/>
- Bauer, M. W.** (2009). The evolution of public understanding of Science-discourse and comparative evidence. *Science, Technology and Society*, 14(2), 221–240. doi: <https://doi.org/10.1177/097172180901400202>
- Bell, L., Lowenthal, C., Sittenfeld, D., Todd, K., Peifle, S. and Kunz Kollmann, E.** (2018). Public Engagement with Science - A Guide to Creating Conversations Among Publics and Scientists for Mutual Learning and Societal Decision-Making. Museum of Science. Url http://www.nisenet.org/sites/default/files/pes_guide_09_13pdf.pdf
- Bonney, R., Ballard, H. L., Jordan, R. C., McCallie, E., Phillips, T. B., Shirk, J. L., and Wilderman, C. C.** (2009). Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. A CAISE Inquiry Group Report. *A CAISE Inquiry Group Report*, (July), 58. Url <http://files.eric.ed.gov/fulltext/ED519688.pdf>
- Bonney, R., Phillips, T. B., Ballard, H. L. and Enck, J. W.** (2016). Can citizen science enhance public understanding of science?. *Public Understanding of Science*, 25(1), 2-16. doi: 10.1177/0963662515607406
- Boyla, K.A., Sinav, L. and Dizdaroğlu D.E.** (2019). Türkiye Üreyen Kuş Atlası. WWF-Türkiye, Doğal Hayatı Koruma Vakfı. İstanbul. Url http://d2hawiim0tjbd8.cloudfront.net/downloads/turkiye_ureyen_ku_atlas.pdf
- Callon, M.** (1984). Some elements of sociology of translation: domestication of scallops and the fishermen of St. Brieuc Bay. *The Sociological Review*, 32(1_suppl), 196–233. doi: <https://doi.org/10.1111/j.1467-954X.1984.tb00113.x>

Citizen Science Community Resources (n.d.). The Power Of A Few: Citizens Use Science to Stop Illegal Polluter. Retrieved from <https://csresources.org/our-history>

CIESM (n.d.). CIESM JellyWatch Program. Retrieved from <http://www.ciesm.org/marine/programs/jellywatch.htm>

Cooper, C. B. and Lewenstein, B. V. (2016). Two meanings of Citizen Science. *The Rightful Place of Science: Citizen Science*, 51–62. doi: <https://doi.org/10.1037/0033-2909.126.1.78>

Cooper, C., Larson, L., Holland, K. K., Gibson, R., Farnham, D., Hsueh, D., ... McGillis, W. (2017). Contrasting the views and actions of data collectors and data consumers in a volunteer water quality monitoring project: implications for project design and management. *Citizen Science: Theory and Practice*, 2(1). 1-14.

Curtis, V. (2018). *Online Citizen Science and the Widening of Academia*. *Online Citizen Science and the Widening of Academia*. doi: <https://doi.org/10.1007/978-3-319-77664-4>

Dickinson, J.L. and Bonney, R. (2012). Introduction: Why Citizen Science?. J.L. Dickinson and R. Bonney (Eds.). *Citizen Science Public Participation in Environmental Research*. (1st ed., pp.1-14). Cornell University Press. Retrieved from <http://www.jstor.org/stable/10.7591/j.ctt7v7pp>

Dizdaroğlu, D.E., Sinav, L., Şahin, D. and Boyla, K.A. (2017). Filling the gap: the first Breeding Bird Atlas of Turkey. *Vogelwelt* (137), 29-32.

Dizdaroğlu, E. and Boyla, K.A. (2017). Turkish Breeding Bird Atlas: A Big Challenge in a Big Country. *Bird Census News 2017*, 30(1) European Atlas News 19-23. Url http://bigfiles.birdlife.cz/ebcc/BCN/BCN_30_1.pdf

Donald, P. F., Heldbjerg, H., Oppel, S., Kamp, J., and Nyegaard, T. (2016). Unstructured citizen science data fail to detect long-term population declines of common birds in Denmark. *Diversity and Distributions*, 22(10), 1024–1035. doi: <https://doi.org/10.1111/ddi.12463>

EBCC (n.d.). What is EBBA2 and why EBBA2. Retrieved from <https://www.ebba2.info/what-is-ebba2-and-why-ebba2/>

Elliott, K. C. and Rosenberg, J. (2019). Philosophical Foundations for Citizen Science. *Citizen Science: Theory and Practice*, 4(1): 9, 1–9, doi: <https://doi.org/10.5334/cstp.155>

Ejolt (n.d.). Project. Retrieved from <http://www.ejolt.org/project/>

Env.Net (n.d.). About Us-The Network. Retrieved from <http://env-net.org/about-us/the-network/>

European Citizen Science Association (ECSA). (2015). *Ten Principles of Citizen Science*. Retrieved from https://ecsa.citizen-science.net/sites/default/files/ecsa_ten_principles_of_citizen_science.pdf

Farmer, G. Thomas. (2015). *Modern Climate Change Science: An Overview of Today's Climate Change Science*. Las Cruces NM, USA: Springer. doi: 10.1007/978-3-319-09222-5

Felt, U. (1999). Why Should the Public Understand Science? A Historical Perspective on Aspects of The Public Understanding of Science. In Meinolf, D & Claudia, G. (Eds.) *Between Understanding and Trust. The Public, Science and Technology*. Amsterdam: Harwood Academic Publishers.

Ferran-Ferrer, N. (2015). Volunteer participation in citizen science projects. *El Profesional de la Informacion*. 24(6), 827-837. doi: <https://doi.org/10.3145/epi.2015.nov.15>

Fournier, A. (2016). Deficit and Dialogue Models of Science Communication (Image). Retrieved April 1, 2019, from https://www.researchgate.net/figure/Deficit-and-Dialogue-Models-of-Science-Communication-1-3-T-D-D-I-F-F_fig3_310787142

Fritz, S., See, L., Carlson, T., Haklay M. M., Oliver, J. L., Fraisl, D., ... West, S. (2019). Author Correction: Citizen Science and The United Nations Sustainable Development Goals. *Nature Sustainability* 2, 1063 doi: <https://doi.org/10.1038/s41893-019-0426-8>

Funtowicz, S. O. and Ravetz, J. R. (2020). Science for the Post-Normal Age. The Knowledge Futures Commonplace. doi: <https://doi.org/10.21428/6ffd8432.8a99dd09>

GalaxyZoo (n.d.). Retrieved from <https://www.zooniverse.org/projects/zookeeper/galaxy-zoo>

Geoghegan, H., Dyke, A., Pateman, R., West, S., and Everett, G. (2016). Understanding motivations for citizen science. *Final report on behalf of UKEOF, University of Reading, Stockholm Environment Institute (University of York) and University of the West of England*. Url <http://www.ukeof.org.uk/resources/citizen-science-resources/MotivationsforCSREPORTFINALMay2016.pdf>

Golumbic, Y. N., Orr, D., Baram-Tsabari, A., and Fisbain, B. (2017). Between Vision and Reality: A Study of Scientists' Views on Citizen Science. *Citizen Science: Theory and Practice*, 2(1), 6. doi: <http://doi.org/10.5334/cstp.53>

Havens, K. and Henderson, S. (2013). Citizen Science Takes Root. *American Scientist*, 101(5), 378. doi: <https://doi.org/10.1511/2013.104.378>

- Hecker, S., Bonney, R., Haklay, M., Hölker, F., Hofer, H., Goebel, C., ... Bonn, A.** (2018). Innovation in Citizen Science – Perspectives on Science-Policy Advances. *Citizen Science: Theory and Practice*, 3(1), 1–14. doi: <https://doi.org/10.5334/cstp.114>
- Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J., and Bonn, A.** (2018). Innovation in open science, society and policy – Setting the agenda for citizen science. In: Hecker, S. and Haklay, M. and Bowser, A. and Vogel, J. and Bonn, A., (eds.) *Citizen Science: Innovation in Open Science Society and Policy*. 1–24. doi: <https://doi.org/10.2307/j.ctv550cf2.8>
- Heigl, F., Kieslinger, B., Paul, K. T., Uhlik, J., and Dörler, D.** (2019). Opinion: Toward an international definition of citizen science. *Proceedings of the National Academy of Sciences*, 116(17), 8089–8092. doi: <https://doi.org/10.1073/pnas.1903393116>
- Herrando, S., Keller, V., Bauer, H-G., Brotons, L., Eaton, M., Kalyakin, M.,... .Foppen R.** (2019) Using the first European Breeding Bird Atlas for science and perspectives for the new Atlas, *Bird Study*, 66(2), 149-158, doi: [10.1080/00063657.2019.1618242](https://doi.org/10.1080/00063657.2019.1618242)
- Human Computation Institute** (2019). Stall Catchers. Retrieved from <https://stallcatchers.com/main>
- IPCC.** (2018). *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.
- Irwin, A.** (2002). Citizen science: A study of people, expertise and sustainable development. (1st ed.) (ebook). doi: <https://doi.org/10.4324/9780203202395> (Original work published 1995).
- Kocaman, S., Anbaroğlu, B., Uğurlu, A., and Demir, N.** (2017). Coğrafi Bilgi Teknolojilerinin Sivil Bilimdeki Yeri. *Afyon Kocatepe University Journal of Science and Engineering*. 17(4), 112-117.
- Kosmala, M., Wiggins, A., Swanson, A., and Simmons, B.** (2016). Assessing data quality in citizen science. *Frontiers in Ecology and the Environment*, 14(10), 551–560. doi: <https://doi.org/10.1002/fee.1436>
- Kragh, G.** (2016). The motivations of volunteers in citizen science. *environmental SCIENTIST*, 25(2), 32-35. Url <http://eprints.bournemouth.ac.uk/24680/1/Kragh2016%20The%20motivations%20of%20volunteers%20in%20citizen%20science.pdf>

- Kullenberg, C. and Kasperowski, D.** (2016). What is citizen science? - A scientometric meta-analysis. *PLoS ONE*, 11(1), 1–16. doi: <https://doi.org/10.1371/journal.pone.0147152>
- Kustr.org** (n.d.). Türkiye Üreyen Kuş Atlası-Turkish Breeding Bird Atlas. Retrieved from <http://kustr.org/kusatlası/>
- Kustr.org** (n.d.). Turkish Breeding Bird Atlas. Url http://kustr.org/kusatlası/wp-content/uploads/2016/11/Turkish-Breeding-Bird-Atlas_step-by-step.pdf
- Kyba, C. C. M., Virapongse, A., Cappadonna, J. L., Heigl, F., Cooper, C. B., Jiang, Q., ... Eitzel, M. V.** (2017). Citizen Science Terminology Matters: Exploring Key Terms. *Citizen Science: Theory and Practice*, 2(1), 1. doi: <https://doi.org/10.5334/cstp.96>
- Latour, B.** (2005). Reassembling the Social. An Introduction to Actor-Network-Theory. New York: Oxford University Press.
- Lave, R.** (2012). Neoliberalism and the production of environmental knowledge. *Environment and Society*, 3(1), 19-38. Url <http://www.envirosociety.org/wp-content/uploads/2015/07/3.2-Rebecca-Lave-Neoliberalism-and-the-Production-of-Environmental-Knowledge.pdf>
- Law, J.** (2017). STS as Method. In Felt, U., Fouche, R., Miller, C. and Smith-Doerr, L. (eds.). *The Handbook of Science and Technology Studies*. (4th ed.). Cambridge, MA: The MIT Press. eISBN 9780262338103
- Martin, V. Y.** (2017). Citizen science as a means for increasing public engagement in science: presumption or possibility?. *Science Communication*, 39(2), 142-168.
- Monarch Lab** (2018). Education & Gardening. Retrieved from <https://monarchlab.org/education-and-gardening>
- Özbakır, Ali. and Aydın, Cem.** (2017). Mapping is Learning. In *EarthEd (State of the World): Rethinking Education on a Changing Planet*. (1st ed., pp.139-140). Island Press.
- Öztürk, B., Topaloglu, B., Sümen, S.G., Turan, C., İşinibilir, M., Aktaş, Ş., and Özen, Ş.** (2018). Jellyfish of The Black Sea and Eastern Mediterranean Waters. Turkish Marine Research Foundation (TUDAV). Publication No. 48, Istanbul, Turkey. 75 Pages.
- Robinson, L. D., Cawthray, J. L., West, S. E., Bonn, A., and Ansine, J.** (2018). Ten principles of citizen science. In: Hecker, S. and Haklay, M. and Bowser, A. and Vogel, J. and Bonn, A., (eds.) *Citizen Science: Innovation in Open Science Society and Policy*. 27-51 UCL Press, London.

- Rouse, J.** (2002). Kuhn's Philosophy of Scientific Practice. In Nickles, T. (ed.) *Thomas Kuhn*. 103-106 Cambridge University Press. Ebook. Retrieved from <https://0-ebookcentral-proquest.com.divit.library.itu.edu.tr/lib/itup/reader.action?docID=217812&ppg=116>
- Seeberger, A.** (2014). *There is No Such a Thing as Free Labour: Evaluating Citizen Science Volunteer Motivations* (Master Thesis). University of Colorado Museum of Natural History, United States. Retrieved from https://pdfs.semanticscholar.org/f596/66f81555480efed06fcfa82739164adbc14a.pdf?_ga=2.89849369.385578511.1595512454-1307856574.1595512454
- Shankar, K., Hakken, D., and Østerlund, C.** (2017). Rethinking Documents. In Felt, U., Fouche, R., Miller, C. and Smith-Doerr, L. (eds.). *The Handbook of Science and Technology Studies*. (4th ed.). Cambridge, MA: The MIT Press. eISBN 9780262338103
- Shirk, J., Ballard, H., Wilderman, C., Phillips, T., Wiggins, A., Jordan, R., ... Bonney, R.** (2012). Public participation in scientific research: a framework for deliberate design. *Ecology and society*, 17(2). doi: <http://dx.doi.org/10.5751/ES-04705-170229>
- Shirk, J. L. and Bonney, R.** (2018). Scientific impacts and innovations of citizen science. In: Hecker, S. and Haklay, M. and Bowser, A. and Vogel, J. and Bonn, A., (eds.) *Citizen Science: Innovation in Open Science Society and Policy*. 41-51. UCL Press: London.
- Sinav, L.** (2019). *The Pattern of Geographic Variation of Bird Species Richness in Turkey* (Master's Thesis). Hacettepe University, Ankara, Turkey. Retrieved from <http://www.openaccess.hacettepe.edu.tr:8080/xmlui/bitstream/handle/11655/9375/10265636.pdf?sequence=3&isAllowed=y>
- Strasser, B. J., Baudry, J., Mahr, D., Sanchez, G., and Tancoigne, E.** (2019). “Citizen Science”? Rethinking Science and Public Participation. *Science & Technology Studies*, 1–25. doi: <https://doi.org/10.23987/sts.60425>
- Strasser, B. J. and Haklay, M.** (2018). Citizen Science: Expertise, Democracy and Public Participation. Swiss Science Council. Url https://discovery.ucl.ac.uk/id/eprint/10062223/1/Policy_Analysis_SSC_1_2018_Citizen_Science_WEB.pdf
- Team eBird** (2015). eKuşbankBaşlarken. Retrieved from <https://ebird.org/turkey/news/baslarken>
- TEMA Vakfı** (2016). Türkiye Su Varlıklarına Yönelik Tehditler Haritası Değerlendirme Raporu. Url http://sertifika.tema.org.tr/_Ki/SuTehditleriHaritasi/download/TEMA_Su_Tehditleri_Haritasi_Değerlendirme_Raporu.pdf

- TEMA Vakfı** (2016). Türkiye Su Varlıklarına Yönelik Tehditler Haritası. Retrieved March 7, 2019, from http://sertifika.tema.org.tr/_Ki/SuTehditleriHaritasi/
- TEMA Vakfı** (2016). The Distribution of Threats According to The Cities (Figure). Retrieved from http://sertifika.tema.org.tr/_Ki/SuTehditleriHaritasi/download/TEMA_Su_Tehditleri_Haritasi_Değerlendirme_Raporu.pdf
- Tezcan, Özgür. D.** (n.d.). Jellyfish Sting Treatment. Retrieved October 5, 2019, from <http://yayakarsa.org/en/watch-for-jellyfish/jellyfish-sting-treatment/>
- The Cornell Lab** (n.d.). Project FeederWatch. Retrieved from <https://feederwatch.org>
- The Cornell Lab of Ornithology** (n.d.). eBird. Retrieved from <https://ebird.org/home>
- Trench, B.** (2008). Towards an Analytical Framework of Science Communication Models. In *Communicating Science in Social Contexts* (pp. 119–135). Dordrecht: Springer Netherlands. doi: https://doi.org/10.1007/978-1-4020-8598-7_7
- TUDAV** (n.d.). The Aim of The Project. Retrieved from <http://yayakarsa.org/en/about-yayakarsa-org/the-aim-of-the-project/>
- TUDAV** (2014). The National Jellyfish and Gelatinous Organisms Watch Programme. Retrieved from <http://yayakarsa.org/index.php/en>
- TUDAV** (2020). Jellyfish Identified (Image). Retrieved July 23, 2020, from <http://yayakarsa.org>
- Türkiye Üreyen Kuş Atlası** (2019). The Distribution and Abundance Map of Sardinian Warbler (Image). Retrieved from http://d2hawiim0tjbd8.cloudfront.net/downloads/turkiye_ureyen_ku_atlas.pdf
- Ufuk 2020** (n.d.). Toplum ile Toplum için Bilim. Retrieved from <https://h2020.org.tr/tr/tematik-alanlar/toplum-ile-toplum-icin-bilim>
- Ulakbim** (n.d.). *TUBITAK Open Science Policy*. Retrieved from <https://acikveri.ulakbim.gov.tr/wp-content/uploads/2019/03/TUBITAK-Open-Sciency-Policy.pdf>
- Us, H.** (2019). Türkiye'deki Vatandaş Bilimine Dair Bir İnceleme. An Investigation on Citizen Science in Turkey. A. Turanlı (Ed.), Forthcoming in *Türkiye'de STS: Bilim ve Teknoloji Çalışmalarına Giriş*. İstanbul Teknik Üniversitesi Yayınları.
- Whitmarsh, L., Seyfang, G., and O'Neill, S.** (2011). Public engagement with carbon and climate change: To what extent is public 'carbon capable'? *Global Environmental Change*, 21. pp.56-65.

Ya Yakarsa? (@yayakarsa.tudav). (n.d.). Retrieved from <https://www.facebook.com/yayakarsa.tudav/>

yayakarsa (@yayakarsa). (n.d.). Retrieved from <https://www.instagram.com/yayakarsa/>

YaYakarsa (@YaYakarsa). (2014). Retrieved from <https://twitter.com/YaYakarsa>

Zooniverse (n.d.). people - powered research. Retrieved from <https://www.zooniverse.org>

Personal Communication List:

- 1st Case Coordinator 1, personal communication, 23 July 2019.
- 1st Case Coordinator 2, personal communication, 11 June 2019.
- 1st Case Coordinator 3, personal communication, 27 July 2019.
- 1st Case Citizen Scientist 1, personal communication, 8 July 2019.
- 1st Case Citizen Scientist 2, personal communication, 25 July 2019.
- 1st Case Citizen Scientist 3, personal communication, 29 July 2019.
- 2nd Case Coordinator 1, personal communication, 14 June 2019.
- 2nd Case Coordinator 2, personal communication, 10 July 2019.
- 2nd Case Coordinator 3, personal communication, 10 July 2019.
- 2nd Case Citizen Scientist 1, personal communication, 6 August 2019.
- 2nd Case Citizen Scientist 2, personal communication, 7 August 2019.
- 2nd Case Citizen Scientist 3, personal communication, 26 August 2019.
- 3rd Case Coordinator 1, personal communication, 5 August 2019.

APPENDICES

APPENDIX A: Codebooks of the projects



APPENDIX A

Table A.1: The Turkish Breeding Bird Atlas Codebook.

Name	Description	Files	References
Benefits	Benefits of citizen science based on the project experiences of the coordinator participants and the active citizen scientist participants	2	12
Enrolment	Associations of the human and the non-human actors in the first outcome within the subsequent strategies leading to the project outcome, the coordinator participants' responses on associations affecting the research process, the active citizen scientist participants' responses on associations affecting their data collection process	4	36
Interessement	Associations of the human and non-human actors in the method	3	46
Technology	Roles of the technologies in the project	2	6
Mobilization	Associations of the human and the non-human actors in construction of the outcome by the representative actors	3	16
Problematization	Associations of the human and the non-human actors in construction of the research problem	4	38
Motivations	Motivations of the coordinator participants and the active citizen scientist participants for the project	3	13
Profile of Citizen Scientists	Profile of the project's citizen scientists	2	7
Science	Relations of the project with science and scientific research	4	21
Shortfalls	Shortfalls of citizen science based on the project experiences of the coordinator and the active citizen scientist participants	2	11

Table A.2: The Map of Threats to Water Resources in Turkey Codebook.

Name	Description	Files	References
Benefits	Benefits of citizen science based on the project experiences of the coordinator participants and the active citizen scientist participants	2	14
Enrolment	Associations of the human and the non-human actors in the first outcome, the coordinator participants' responses on associations affecting the research process, the active citizen scientist participants' responses on associations affecting their data collection process	4	16
Interessement	Associations of the human and non-human actors in the method	3	17
Technology	Roles of the technologies in the project	2	6
Mobilization	Associations of the human and the non-human actors in construction of the outcome by the representative actors	4	32
Problematization	Associations of the human and the non-human actors in construction of the research problem	2	15
Motivations	Motivations of the coordinator participants and the active citizen scientist participants for the project	2	4
Profile of Citizen Scientists	Profile of the project's citizen scientists	2	7
Science	Relations of the project with science and scientific research	2	15
Shortfalls	Shortfalls of citizen science based on the project experiences of the coordinator participants and the active citizen scientist participants	2	15

Table A.3: The National Jellyfish and Gelatinous Organisms Watch Program
Codebook.

Name	Description	Files	References
Benefits	Benefits of citizen science based on the first coordinator's project experience	1	1
Enrolment	Associations of the human and the non-human actors in the first outcome, the first coordinator's response on associations affecting the research process	1	2
Interessement	Associations of the human and non-human actors in the method	2	5
Technology	Roles of the technologies in the project	1	1
Mobilization	Associations of the human and the non-human actors in construction of the outcome by the representative actors	2	3
Problematization	Associations of the human and the non-human actors in construction of the research problem	2	5
Motivations	The first coordinator's motivation for the project	1	2
Science	Relations of the project with science and scientific research	1	2
Shortfalls	Shortfalls of citizen science based on the first coordinator's project experience	1	1

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