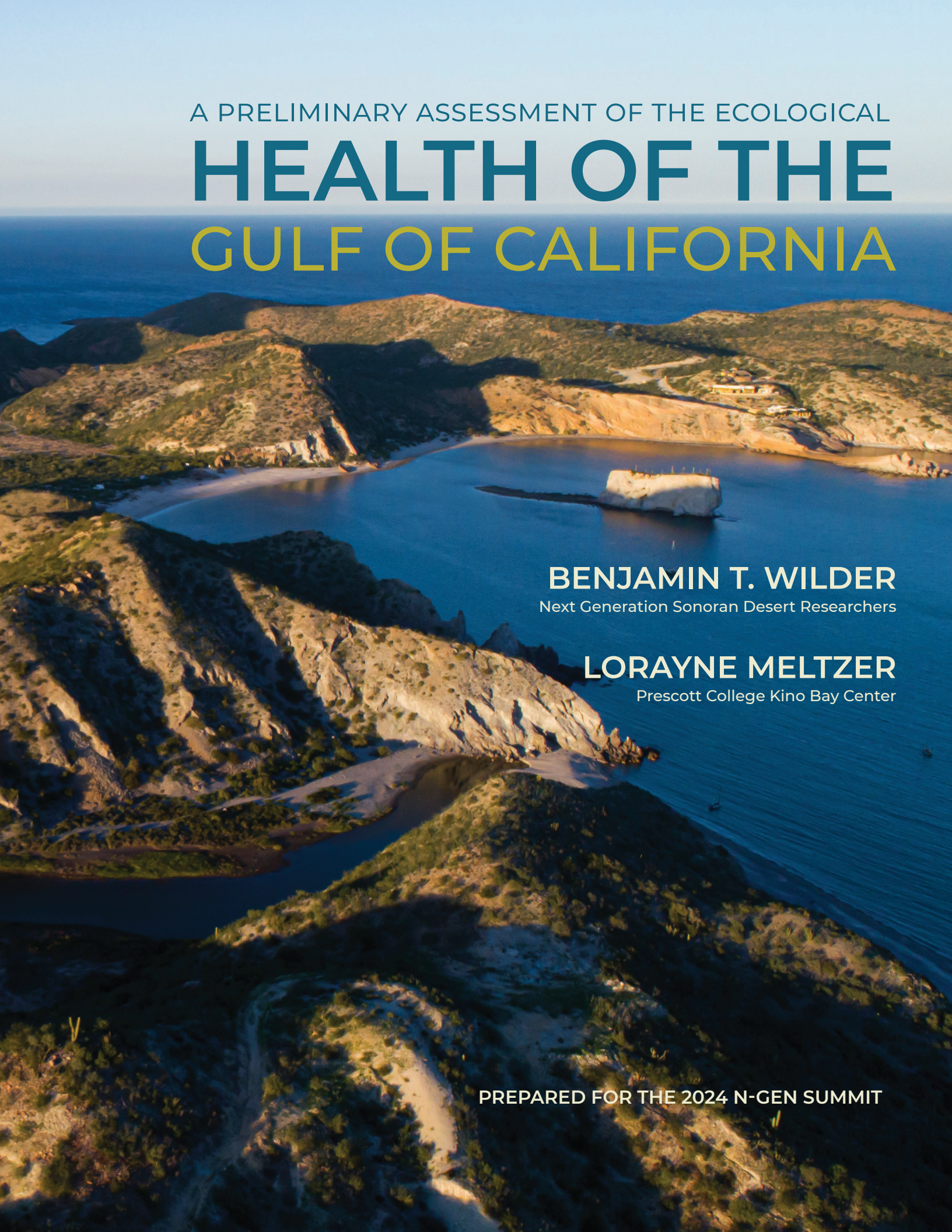
A PRELIMINARY ASSESSMENT OF THE ECOLOGICAL

HEALTH OF THE GULF OF CALIFORNIA



BENJAMIN T. WILDER
Next Generation Sonoran Desert Researchers

LORAYNE MELTZER
Prescott College Kino Bay Center

PREPARED FOR THE 2024 N-GEN SUMMIT

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A Preliminary Assessment of the Ecological Health of the Gulf of California

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April 2024

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Prepared for the April 2024 Summit of the Next Generation Sonoran Desert Researchers

Photo by: John (Verm) Sherman

Overview

What is the health status of the marine and coastal ecosystems of the Gulf of California? All life in the Gulf of California, marine and terrestrial, is connected to climatic and oceanographic cycles on the time scale of years to decades. Likewise, connections between ecosystems drive much of the productivity and ecological dynamics of the region.

There is general uncertainty among the public, policy makers, managers, as well as scientists as to the general status and trajectory of life in the Gulf of California. While change and variability are a constant, what affect are large-scale fishing industries having? What effects are being observed in response to global change and increasing variability in sea surface temperatures? What are the background population dynamics of individual species?

These large questions can often be impossible to answer. However, in the Gulf of California there are dozens of long-term ecological studies focused across the region and across species. These studies, each remarkable on their own, can allow the establishment of baselines to present data to address such large questions.

While the baselines may be different or incomplete, and direct causation often unclear, these long-term studies provide otherwise impossible insights into the status of the Gulf of California, from individual species to the interconnected ecological dynamics of the region.

These data are true gold, not just for science, but for all stakeholders invested in the past and future of the Gulf of California. Despite increasing coordination and outreach efforts these datasets often are unknown, unrecognized, or reside inaccessible within academic silos.

Photo by: John (Verm) Sherman

This effort is focused on creating a current understanding of what long-term studies are available, present what they are saying, and identify what is missing and what actions are needed to have answers to the question, what is the ecological health of the Gulf of California.

The preliminary assessment presented here is a starting point for discussion in a special session on the ecological health of the Gulf of California at the N-Gen Summit in Álamos, Sonora April 25–27, 2024.

Participating Researchers and Studies

STUDY NUMBER	NAME	STUDIES	YEAR INITIATED		REGION(s)	TAXA	STATUS	TREND
1	Peggy J. Turk Boyer	Seasonal and long term trends in rocky intertidal flora and fauna, Puerto Penasco, Sonora	1982		Upper Gulf	44 species of intertidal flora and fauna	2000, with one transect done in 2012 and possibility of continuing	Undetermined
2.1	Hem Nalini Morzaria-Luna	Estructura de la comunidad de peces de dos esteros en el norte del Golfo de California.	2007		Upper Gulf	77 species of fish	2011	Undetermined
2.2	Hem Nalini Morzaria-Luna	Benthic invertebrate community structure in coastal wetlands	2005		Upper Gulf	33 species of invertebrates	2006	Undetermined
3	Enrico A. Ruiz	Demographic history of Heermann's Gull Larus heermanni (Charadriiformes: Laridae) from late Quaternary to present: Effects of past climatic changes in the Gulf of California	2011		Upper Gulf	Heermann's Gull (*Larus heermanni*)	ongoing	Degrading
4	Peter Raimondi	Long term Intertidal Monitoring of the Intertidal in the Gulf of California	1978		Upper Gulf	*Heliaster*, many low to mid intertidal species	intertidal monitoring stopped in 2009. Heliaster data are form 2020-2022	Undetermined
5	Edward H Boyer	Intertidal ecology	Earliest part was early 1970s, most recent data sets from early 1990s		Upper Gulf, Midriff Islands	*Heliaster kubinijii,* and dozens of other species of marine intertidal invertebrates	ongoing	Degrading
6	Drew M. Talley	Spatial Subsidy in Island Ecosystems	1988		Mid Peninsula (Bahía de Los Ángeles to Loreto)	Tenebrionid beetles, darkling beetles	ongoing	Improving

STUDY NUMBER	NAME	STUDIES	YEAR INITIATED		REGION(s)	TAXA	STATUS	TREND
7	Michelle María Early Capistrán	Conectando el pasado con el presente: evaluación a largo plazo de la abundancia de tortuga prieta en el Golfo de California	2017		Mid Peninsula (Bahía de Los Ángeles to Loreto)	East Pacific green turtle, *Chelonia mydas*	ended 2021	Undetermined
8.1	Maria Clara Arteaga	Ecología y genética de la conservación de especies de yucas y sus polinizadores	2013		Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Coastal Peninsula (Loreto and south), Upper Gulf	*Yucca schidigera, Y. valida, Y. capensis, Tegeticula mojavella, T. baja*	ended 2019	Degrading
8.2	Maria Clara Arteaga	Hesperoyuccas de la península: biología reproductiva e interacciones ecológicas	2022		Upper Gulf,Mid Peninsula (Bahía de Los Ángeles to Loreto)	*Hesperoyucca peninsularis, H. whipplei, Tegeticula maculata, Prodoxus marginatus, Scyphophorus yuccae*	ongoing	Undetermined
9	Gisela Heckel	Diversity and distribution of cetaceans in Ballenas Channel and Los Ángeles Bay. Fin whale and euphausiid distribution.	2003		Midriff Islands	Fin whale (*Balaenoptera physalus*), Bryde's whale (*Balaenoptera edeni*), long-beaked common dolphin (*Delphinus delphis*), bottlenose dolphin (*Tursiops truncatus*), Risso's dolphin (*Grampus griseus*), euphausiids (*Nyctiphanes simplex*)	2005	Undetermined
10	Misael Daniel Mancilla Morales	Microbiome in Seabirds from Isla Rasa, Gulf of Califronia	2019		Midriff Islands	Heermann's Gull (*Larus heermanni*), Elegant Tern (*Thalasseus elegans*), and Royal Tern (*Thalasseus maximus*)	ongoing	Undetermined
11	Ben Wilder	Cardones of Isla San Pedro Mártir	2007		Midriff Islands	Cardón, *Pachycereus pringlei*	ongoing	Improving
12	Alberto Búrquez	Ecology and biogeography of columnar cacti	2012		Midriff Islands,Lower Coastal Sonora (Guaymas and south), Mid Peninsula (Bahía de Los Ángeles to Loreto)	Pachycereeae, Flora and vegetation	ongoing	Undetermined
13.1	Silvia Gomez Jimenez	Variables ambientales de zonas estuarinas en el Noroeste de Mexico y su impacto en la ecofisiologia de inevertebrados	2023		Midriff Islands	Pacific oyster, *Crassostrea gigas*	ongoing	Undetermined

STUDY NUMBER	NAME	STUDIES	YEAR INITIATED		REGION(s)	TAXA	STATUS	TREND
13.2	Silvia Gomez Jimenez	Fotodocumentacion de cetaceos marinos en la region de las grandes islas	2022		Midriff Islands	*Balaenoptera physalus* (ballena de aleta); *Megaptera novaeangliae* (ballena jorobada)	ongoing	Undetermined
14.1	Waterbird Monitoring Program, Prescott College for Cultural and Ecological Studies	Double-crested Cormorant nest count and productivity surveys on Alcatraz Island, Gulf of California, México	2000 (nest counts), 2018 (productivity)		Midriff Islands	Cormorant	ongoing	Degrading
14.2	Waterbird Monitoring Program, Prescott College for Cultural and Ecological Studies	Exito reproductivo del mérgulo de Craveri en Isla Alcatraz e Isla San Pedro Mártir	2018		Midriff Islands	*Syntlhiboramphus craveri,* Craveri's Murrelet, Mérgulo de Craveri	ongoing	Stable
14.3	Waterbird Monitoring Program, Prescott College for Cultural and Ecological Studies	Estatus poblacional del Pelícano Café (*Pelcanus occidentalis*) en Isla Alcatraz	2005		Midriff Islands	*Pelecanus occidentalis*, Brown Pelican, Pelícano Café	ongoing	Degrading
15.1	Héctor Pérez Puig	Riqueza y diversidad de cetáceos en la Región Oriental de las Grandes Islas del Golfo de California	2009		Midriff Islands	Cetáceos y pinnipedos.	ongoing	Degrading
15.2	Héctor Pérez Puig	Distribución espacial y temporal de cetáceos en la Región Oriental de las Grandes Islas del Golfo	2009		Midriff Islands	Cetáceos y pinnipedos.	ongoing	Rapidly Degrading

STUDY NUMBER	NAME	STUDIES	YEAR INITIATED		REGION(s)	TAXA	STATUS	TREND
16	Comunidad y Biodiversidad, A.C.	Monitoreo submarino asociados a reservas marinas en el Golfo de California. Isla San Pedro Nolasco (2011), Reserva de la Biosfera Isla San Pedro Mártir (2007), Puerto Libertad (2012), Parque Nacional Bahía de Loreto (2008). Contamos con datos de otros sitios en el golfo de california, pero las seres de tiempo no son superiores a los tres años. Si bien la actividade de colecta de datos de en algunos sitios ha conlcuido, aun se siguen realizando otras colaboraciones asociadas a las reservas marinas los sitios antes mencionados	(2011), (2007), (2012), (2008).		Midriff Islands,Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Coastal Sonora (Guaymas and south)	60 especies de invertebrados y 90 de peces.	ongoing through collaborations	Stable
17	Miguel Á. Cisneros-Mata	Pesquería de jaiba en Sonora	1986		Midriff Islands,Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Coastal Sonora (Guaymas and south), Lower Coastal Peninsula (Loreto and south), Lower Gulf (in Gulf south of Midriff Islands)	Warrior Swimming crab, *Callinectes bellicosus*	ongoing	Degrading
18	Ricardo Rodríguez Medina	Análisis de la ocurrencia e interacción patógenoambiente en enfermedades de mamíferos, aves y reptiles de las islas del golfo de california	2020		Upper Gulf,Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Gulf (in Gulf south of Midriff Islands)	12 especies	2021	Undetermined
19	Daniel W. Anderson	Marine bird ecology and conservation	1969		Upper Gulf,Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Gulf (in Gulf south of Midriff Islands)	California Brown Pelican (*Pelecanus occidentalis californicus*); Osprey (*Pandion haliaeetus*)	ongoing	Degrading
20	José Juan Flores Martínez	Conservación del murciélago pescador Myotis vivesi	2003		Upper Gulf, Midriff Islands, Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Coastal Sonora (Guaymas and south), Lower Coastal Peninsula (Loreto and south), Lower Gulf (in Gulf south of Midriff Islands)	Murciélago pescador, fish-eating bat, *Myotis vivesi*	ongoing	Stable

STUDY NUMBER	NAME	STUDIES	YEAR INITIATED		REGION(s)	TAXA	STATUS	TREND
21	Richard C. Brusca	Biodiversity & Conservation in the Sea of Cortez	1969		Upper Gulf, Midriff Islands, Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Coastal Sonora (Guaymas and south),Lower Coastal Peninsula (Loreto and south), Lower Gulf (in Gulf south of Midriff Islands)	All marine species in the Gulf of California	ongoing	Stable
22	Adrian Munguia-Vega	A 3D map of marine biodiversity of eukaryotes from the Gulf of California	2016		Midriff Islands, Mid Peninsula (Bahía de Los Ángeles to Loreto), Lower Coastal Sonora (Guaymas and south), Lower Coastal Peninsula (Loreto and south-),Lower Gulf (in Gulf south of Midriff Islands)	Over 20,000 operational taxonomic units from 50+ phyla have been identified	ongoing	Undetermined
23	Lourdes Martinez Estevez	Ecology and conservation of hawksbill sea turtles in the Gulf of California, Mexico	2014		Lower Coastal Peninsula (Loreto and south), Lower Gulf (in Gulf south of Midriff Islands)	Hawksbill sea turtle, tortuga carey, *Eretmochelys imbricata*	ongoing	Improving
24	Carlos Robinson	Estudio de la re silencia del Golfo de California ante los recientes cambio de productividad y temperatura; Resilience of the ecosystems, fisheries and marine-based economy under a persistent anomalous warm and low-productivity regime in the Gulf of California	2012		Lower Gulf (in Gulf south of Midriff Islands)	Humboldt squid, Calamar Gigante, *Dosidicus gigas*	ongoing	Degrading

Methodology

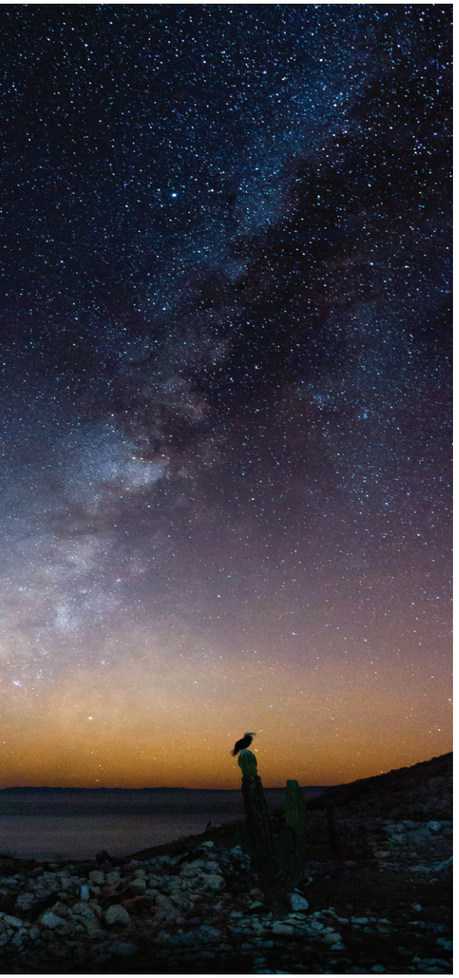


Photo by: John (Verm) Sherman

The information presented here is based on a bilingual (Spanish and English) survey conducted in February and March 2024, https://sites.google.com/prescott.edu/gulfofcalifornias-tudy/home. The survey was created by the authors of this report and shared widely among Gulf of California Researchers. The goal of the survey was to:

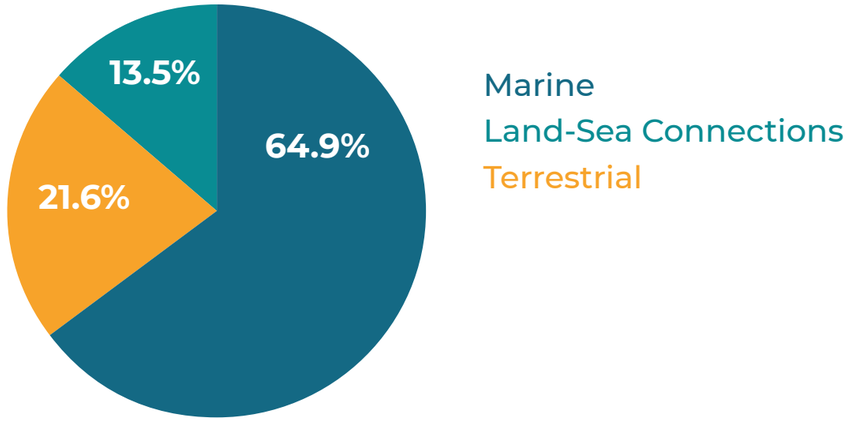
1. Establish a metadatabase of what data exists where (initial studies, Table 1);
2. Identify trends across a wide variety of taxonomic groups and studies;
3. Use this information to develop a status report that communicates general trends. This document is a preliminary version of this report.

The survey has three sections, (1) Researchers, (2) Studies, (3) Trends. In the first section we are collecting basic data about the scientists, their affiliation, collaborators, and data curation. The Studies section is the core of the survey and is where the scientists share the work they are doing, what taxa it is focused on, where, and for how long they have been doing the work. A researcher can enter multiple studies. The final section is where researchers can enter in the trends they may be observing for each of their studies.

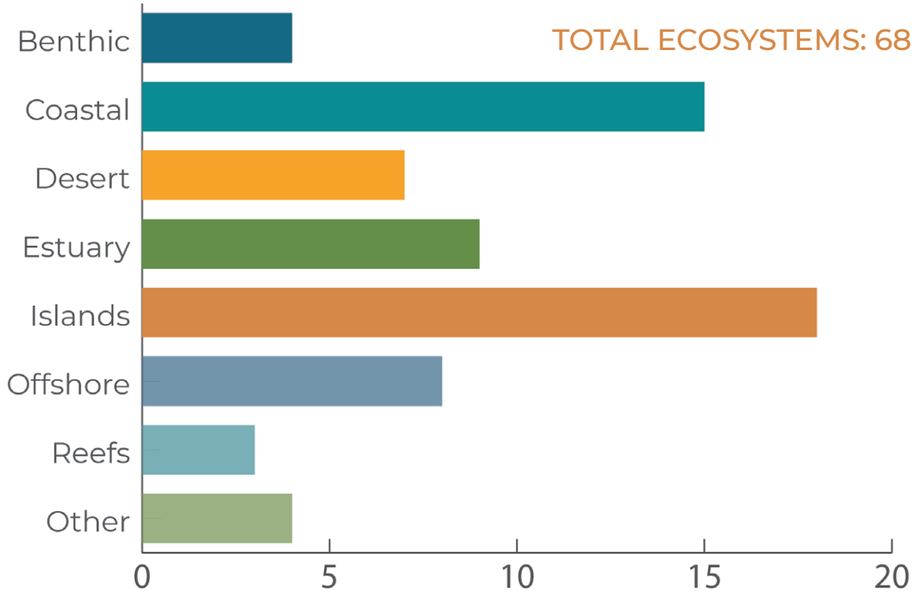
A total of 24 researchers submitted information on 30 studies during the survey window (Table 1). This is the only information used in this preliminary assessment.

By the numbers

REGION/BIOME

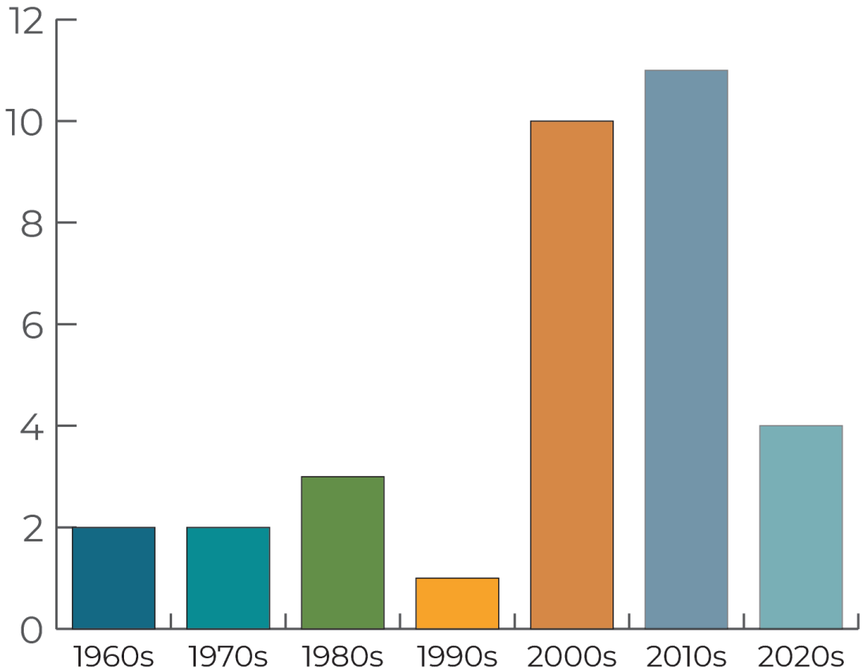


ECOSYSTEM

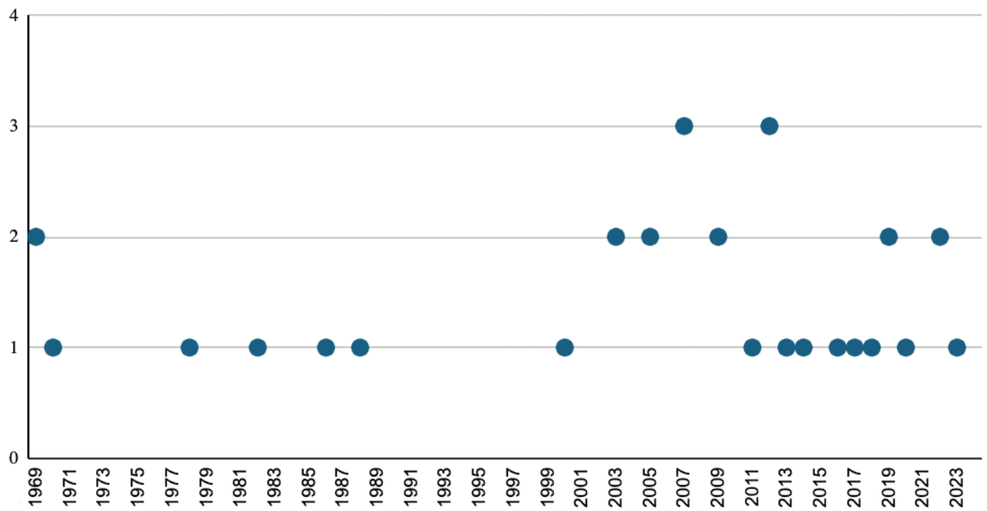


STUDY PERIODS

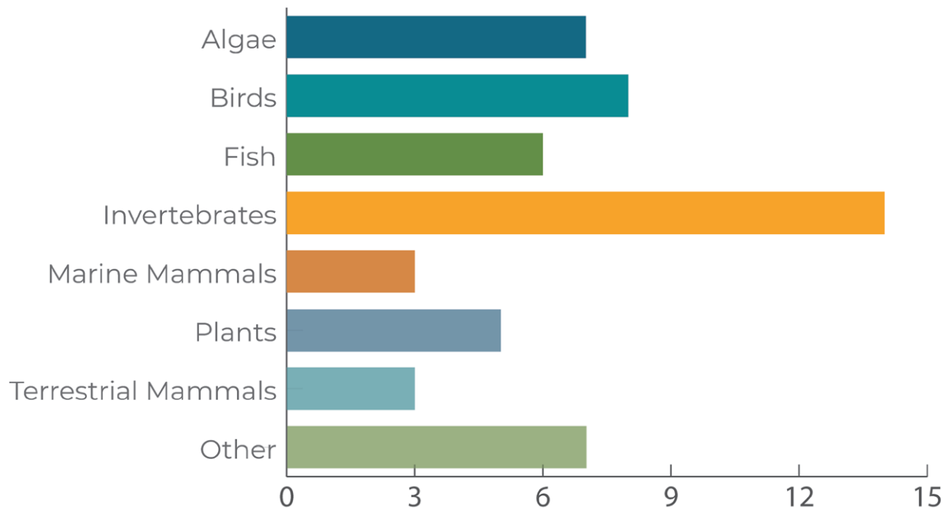
TOTAL STUDIES PER DECADE



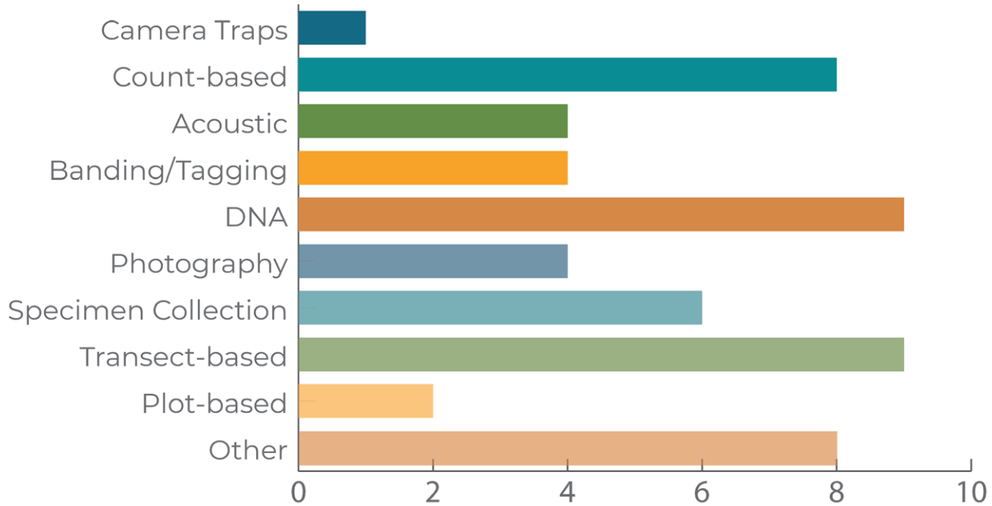
NUMBER OF STUDIES BY START YEAR



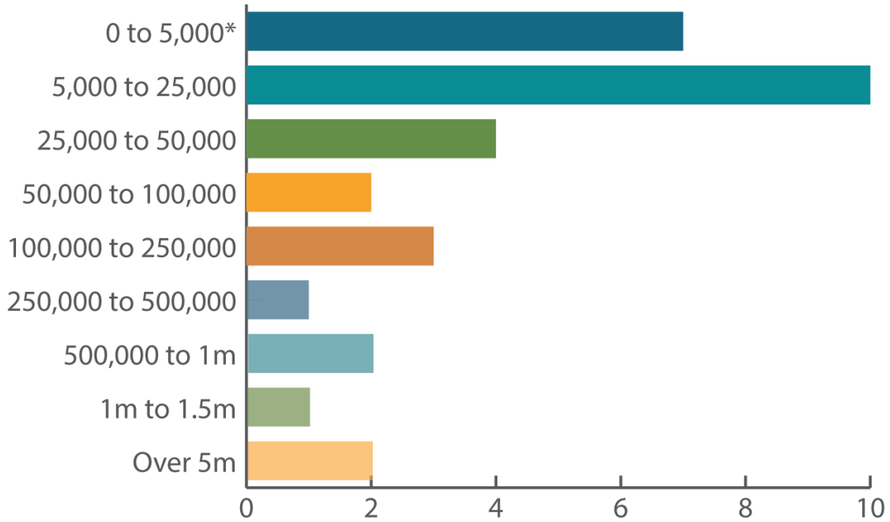
TAXONOMIC GROUPS



METHODS

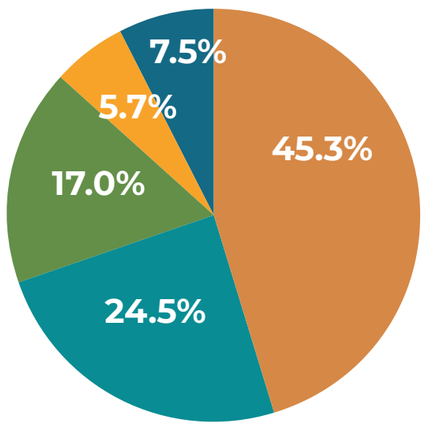


TOTAL FINANCIAL INVESTMENT



CA. $15,000,000 USD INVESTED WITHIN THE 30 STUDIES PRESENTED HERE

REPOSITORY INFO



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Goals of studies

Each of the contributing studies have their own goals, methods, timeframe, and areas of focus. Nonetheless, as long-term studies focused in the Gulf of California, there are many areas of overlap. All contributors gave responses to the question, “Please describe the ecological processes you are investigating in this study (250 words or less).” These responses were edited to focus on goal statements and visualized into this word cloud.

Preliminary Long-Term Study Species & Trends

TIDE POOL

Albula Vulpes
2007

Opisthonema Medirastre
2007

Urobatis Halleri
2007

Paguristes Anahuacus
1982

Barnacles
1982

Morula Ferruginosa
1982

Heliaster Kubinjii
1970/1990

TIDE POOL

California Brown Pelican
1969

Heliaster
1978

Balaenoptera Edeni
2003

Hesperoyucca Peninsularis
2022

Tenebrionid Beetles
1988

Heermann's Gull
2011

Pachycereus Pringlei
2007

Cormorant
2000/2018

Crassostrea Gigas
2023

Elegant Tern
2019

Craveri's Murrelet
2018

Cetaceans and Pinnipeds
2007

Yucca Valida
2013

Chelonia Mydas
2017

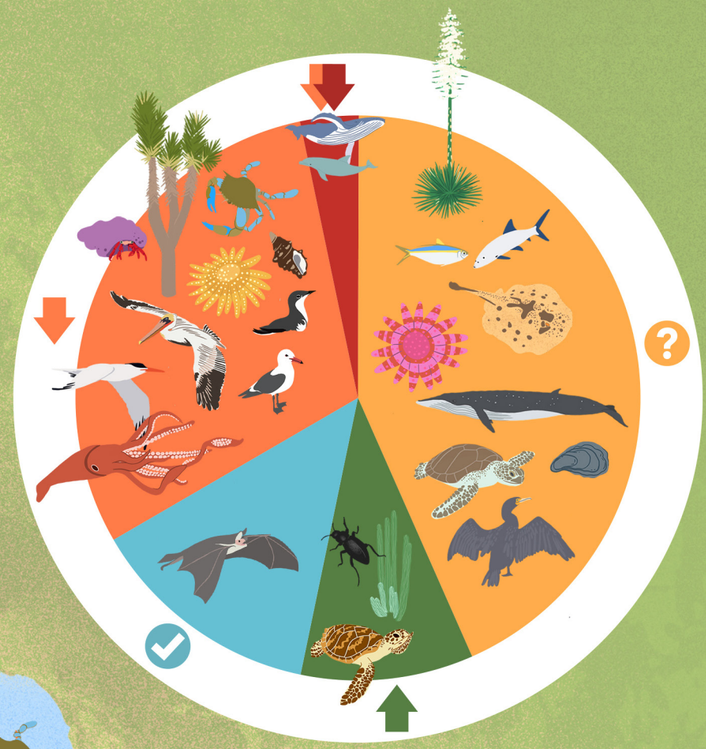
Callinectes Bellicosus
1986

TREND

- Undetermined
- Degrading
- Improving
- Rapidly Degrading
- Stable

YEAR

Years shown indicate the time the studies were initiated



Over 20,000 operational taxonomic units from 50+ phyla have been identified

Myotis Vivesi
2003

Eretmochelys Imbricata
2014

Dodiscus Gigas
2012

What We Know

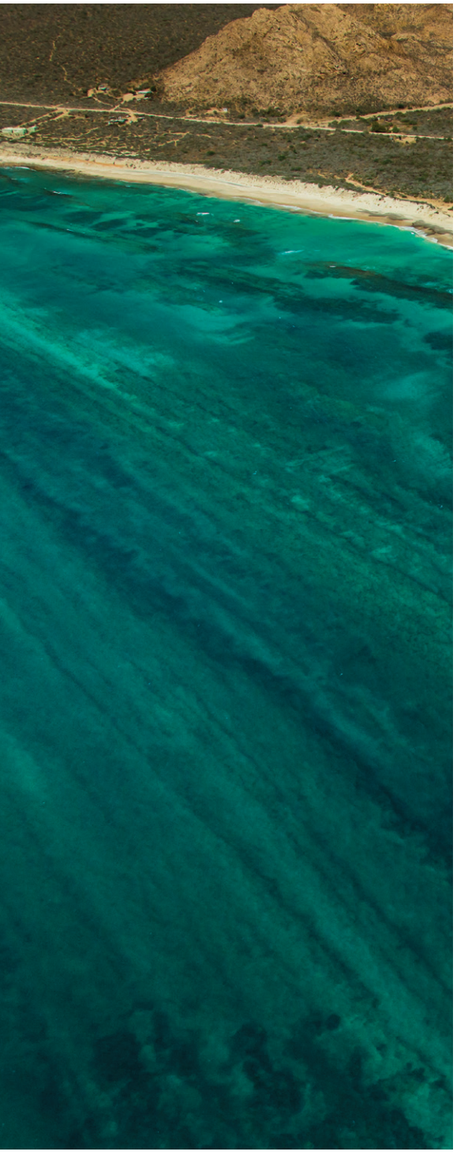


Photo by: Ralph Lee Hopkins — with aerial support by LightHawk

Summaries of the trajectory of select marine and terrestrial species for which trend information was completed are presented here. These overviews are derived from the individual study entries which are indicated with the study number from Table 1.

GENERAL OVERVIEW

Biodiversity & Conservation (throughout Gulf of California)

TREND: Stable

Study 21

Rick Brusca shares, "Over my past 50 years of working in the Gulf, my general impression is that the region remains environmentally quite healthy. The biggest issues, both correctable (in theory) are unsustainable fishing and localized anthropogenic-influenced runoff to the sea (creating low-oxygen regions). It remains to be seen if ocean warming impacts the Gulf. Key reasons why the Gulf remains quite healthy are: influence of Mexican NGOs and academics, extreme tidal flushing from the open Pacific, long stretches of minimally-inhabited coastline on both the E and W shores of the Gulf.

I do not know of a single species that has gone extinct in the Sea of Cortez. Of those that have been impacted (by over-harvesting), nearly all have significant refugial populations somewhere in the Gulf. Even the most threatened species, the vaquita, now has a glimmer of hope with the further emplacement of benthic 'hook devices' that are keeping the totoaba fishers out of the area."

Marine biodiversity of eukaryotes from the Gulf of California throughout Gulf of California)

TREND: Undetermined

Study 22

Diversity levels from the mesopelagic and the deep sea are equal or even higher than in shallow coastal areas. This trend is more related to the lack of information from deep areas of the Gulf as opposed to any environmental impact. Tropicalization of the Central Gulf of California and changes in the bathymetric distribution of multiple species are observed, which shift ecological communities and local food webs. Reduction in phylogenetic diversity, trophic levels and in the complexity of local food webs in heavily impacted sites by human activities (pollution, overfishing, habitat loss and fragmentation). Since the dataset is relatively new, it is hard to say if some of the trends represent interannual or long-term trends. Overall reductions observed range in the 20-40% lower compared to baselines. This is a work in progress.

MARINE MEGAFAUNA

Cetaceans (Midriff Islands)

TREND: Degrading

Studies 15.1 and 15.2

There has been a decrease of the number of individuals observed in recent years, especially in species that were once

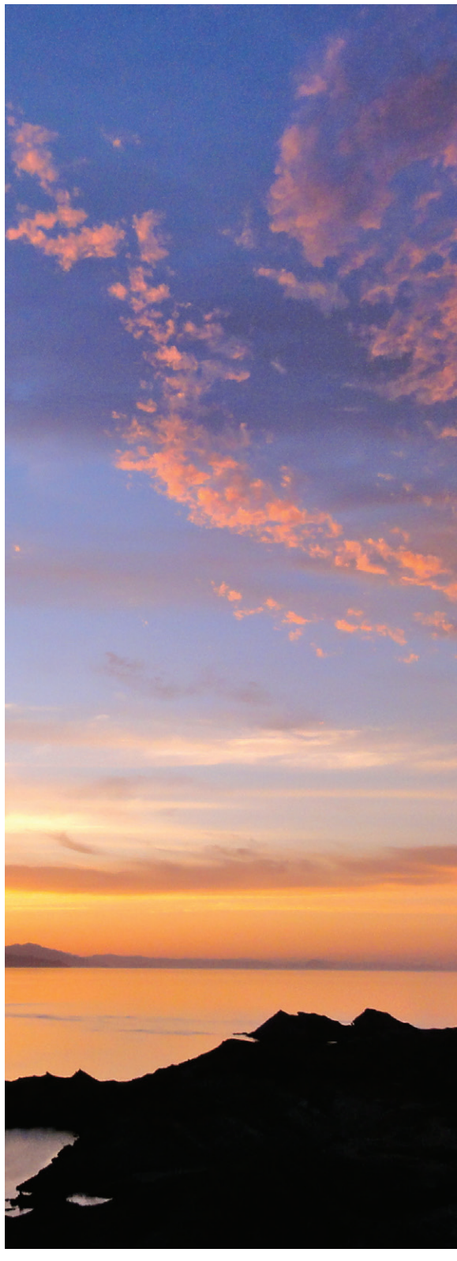


Photo by: Benjamin T. Wilder

abundant. In addition, there has been a substantial decrease in the area where cetacean observations are being made, almost a decrease in two-thirds of the area. There are also fewer observations of young individuals.

Photos by (top to bottom):
Benjamin T. Wilder

Cetaceans (Canal de las Ballenas)

TREND: Undetermined

Study 9

This two year study recorded a slight decrease in fin whale abundance, which was attributed to a weak El Niño during those years.

Hawksbill sea turtle (Lower Coastal Peninsula (Loreto and south), and Lower Gulf (in Gulf south of Midriff Islands)

TREND: Improving

Study 23

Mangroves are a particularly important feeding habitat for the species as they provide a greater quantity and diversity of food and shelter to juveniles and adults. Fishing refuges have turned out to be a positive strategy for the conservation of the species (greater number of individuals identified). Hawksbill turtles have very restricted ranges and high fidelity to their habitats. This presents a great opportunity for their conservation and at the same time a great threat if the habitats on which they depend are degraded. The marine habitats on the islands are very important for hawksbill turtles since the isolation with the peninsula provides them with additional protection. Hawksbill turtles, despite being rarer than other sea turtle species, are recovering. However, this recovery depends strongly on coastal fishing activities, surveillance and the state of mangroves and reefs. The recovery is not the same throughout the Gulf of California and we are still far from the species being no longer in danger of extinction.

Photo by: Benjamin T. Wilder

Fisheating bat (throughout Gulf of California)

TREND: Stable

Study 20

This work is primarily extending baseline information on this species. The fisheating bat (*Myotis vivesi*) has been recorded on 36 islands (17 are new reports) with maternity roosts on 19. A primary roost on Isla Partida Norte was estimated to have a population of ca. 30,000 individuals in 2003. In general the populations of this species do not show evidence of decrease, though it is considered vulnerable due to the location of their populations easily being degraded by human activities.

Photo by: Servando López Monroy

MARINE INVERTEBRATES AND FISH

90 taxa of fish and 60 taxa of invertebrates (Marine Reserves throughout the Gulf of California)

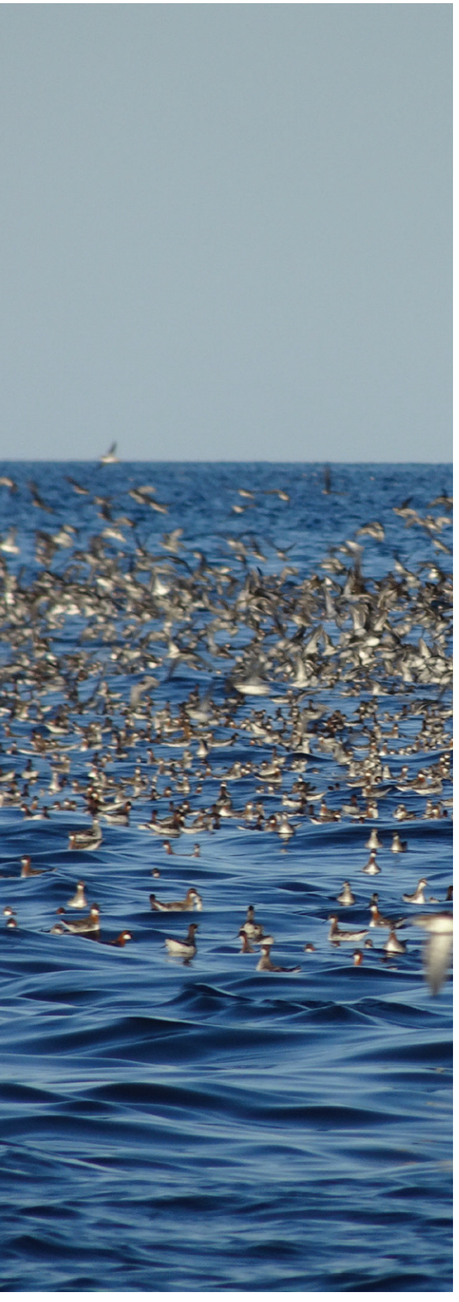


Photo by: Benjamin T. Wilder

TREND: Stable fluctuation (fish), Degrading (Invertebrates)

Study 16

For San Pedro Mártir Island, results indicate a general decrease in invertebrate richness over time, while for fish a fluctuation is observed over the years. It is also observed that the diversity values of invertebrates in 2022 are higher than those of the first 5 years of monitoring, while for fish, the values are higher in the first two years.

A total of 54 species of commercial importance (12 invertebrates and 42 fish species) were recorded for the communities of the San Pedro Mártir Island Biosphere Reserve (ISPMBR). Among the species of high abundance and commercial importance in the ISPMBR were cabrilla sardinera (*Mycteroperca rosacea*), la baya (*Mycteroperca jordani*), la cabrilla pinta (*Mycteroperca prionura*), el pargo amarillo (*Lutjanus argentiventris*) y el cochito (*Balistes polylepis*).

Giant squid (Lower Gulf, in Gulf south of Midriff Islands)

TREND: Degrading

Study 24

Research over the past 15 years has focused on the dynamics of the pelagic ecosystem of the Gulf of California. In October 2012, extreme anomalous oceanographic conditions were encountered in the Gulf. We observed increases in sea temperature and low chlorophyll concentration never seen before, and the most evident was the extreme reduction from 80 cm to 20 cm in the coat length of mature squid. The Gulf of California has had an important change in the oceanography and biology, due to a significant drop in the strength of the spring wind that has reduced the intensity of upwellings. The effect of this warming and impoverishment of the Gulf has been particularly evident in the giant squid. This species supported an important fishery in the area for many years, however this activity no longer exists with the subsequent loss of hundreds of jobs. This anomalous period of low winds, high temperature, and low productivity continues to this day and the next step in the research is to know what effects it may have or has had on other oceanographic processes, fisheries, and components of the pelagic ecosystem of the Gulf of California.

Photo by: Ramiro Arcos Aguilar

Heliaster (Upper Gulf and Midriff Islands)

TREND: Degrading

Study 5

There was a large population crash in 1979-80, some areas of recovery but not in all areas where it was formerly abundant. Recovery has been spotty and indicates continued sensitivity to sea surface temperatures. In other studies on various intertidal invertebrates one finding is the decline in large, predatory gastropods such as *Murex* and other similar species that are subject to human collection. A similar trend is seen in octopuses. Across different species, all seem to be less abundant. In the case of Heliaster, following the initial crash, there was a decline of 90% or more in abundance in many study sites.

Photo by: John (Verm) Sherman

Photo by: John (Verm) Sherman

Swimming crab (throughout Gulf of California)

TREND: Degrading (Guaymas a Yavaros), Stable (Bahía de Kino), Stable (Alto Golfo)

Study 17

Overall per capita productivity fell in the 1990s and is recovering in recent years. The crab in Sonora has a metapopulation structure: sink in the Upper Gulf and source in southern Sonora. This is important for fisheries management.

MEGAFLORA

Cardones (Isla San Pedro Mártir)

TREND: Improving

Study 11

Since the first data point in 2007, this population of cardón cacti has been one of the most healthy measured throughout its range as indicated by regeneration index (number of individuals below 1 m in height) and density. These data points have stayed consistent across sampling periods. In addition, repeat photos show healthy growth of the plants, though not even between periods, and that the plants grow out (new arms) rather than up after a certain height of ca. 5 m. The demographic trend in general is that of a healthy and expanding population.

Yuccas and their pollinators (Baja California)

TREND: Degrading (lack of Yucca recruitment and pollinators), Stable (adult Yuccas)

Study 8.1

Low recruitment has been observed in three Yuccas species (*Yucca schidigera*, *Y. valida*, *Y. capensis*). Their flowering also appears to be asynchronous across years. These three species have high genetic diversity and well formed population structure. Their moth pollinators (*Tegeticula mojavella*, *T. baja*) do not have a genetic diversity structure related to that of their host Yuccas.

SEABIRDS

Cormorants (Isla Alcatraz)

TREND: Degrading

Study 14.1

There is a clear pattern of fewer nests (2010-11, 1,968 nests and in 2023-24, 622, with very low numbers in 2013–2015) and fewer individuals fledging (2018-19, 56% fledging success, 2021-22 28% success). There are also fewer chicks per nest.

Photo by: John (Verm) Sherman

Photo by: John (Verm) Sherman

Photo by: Alan Harper

Craveri's Murrelet (Islas Alcatraz and San Pedro Mártir)

TREND: Stable

Study 14.2

The species has been seen to be consistent in the number and productivity of nest sites on these two islands.

Brown Pelican (Isla Alcatraz)

TREND: Degrading

Study 14.3

Since the beginning of the study of the Brown Pelican on Alcatraz Island there have been many variations. In the early years of the study from 2005 to 2010 the highest number of nests was recorded in 2007-2008 with 1,367 nests. Thereafter, this number decreased until in 2013-2014, there was no nesting for three consecutive years. In 2016-2017 the colony returned and has remained relatively stable since then, with a slight increase in the last three years 2021, 2022 and 2023.

Brown Pelican (throughout Gulf of California)

TREND: Degrading

Study 19

There was an extensive breeding collapse in 2014 related to the anomalous BLOB of warm water in the Eastern Pacific. There has been gradual recovery, especially since 2019. The gradual recovery of Gulf of California breeding populations is speculated to most closely be related to commercial fisheries competition (bycatch and food depletion).

Osprey (throughout Gulf of California)

TREND: Stable

Study 19

Osprey have undergone a major shift in the last three to four decades from nesting on natural substrates to nesting on various electrical and other power poles and towers, and their numbers are apparently stable.

PATHOGENS

Various taxa (Upper Gulf, Mid Peninsula (Bahía de Los Ángeles to Loreto), and Lower Gulf (in Gulf south of Midriff Islands)

TREND: Undetermined

Study 18

This work has provided initial baseline information. An increase is observed in the number of publications referring to pathogen-host studies in the Midriff island region during the last three years. The reported and refined information shows 451 records of pathogens on the islands, classified into 85 genera. Through an exhaustive bibliographic review, covering the period 2000 to 2021, 451 records of pathogenic agents georeferenced to the Gulf of California region were identified: 66.16% of the records correspond to bacteria, 19.73% to ecto/endoparasites, 11.90% to viruses and 2.21% to protozoans. Of the total records, 387 indicate the host species in which they were identified, with 12 host genera reported (7 mammals, 3 birds and 2 reptiles). The pathogenic agents are taxonomically distributed in 85 genera, of which 60 have been identified with zoonotic potential.

Photo by: Benjamin T. Wilder

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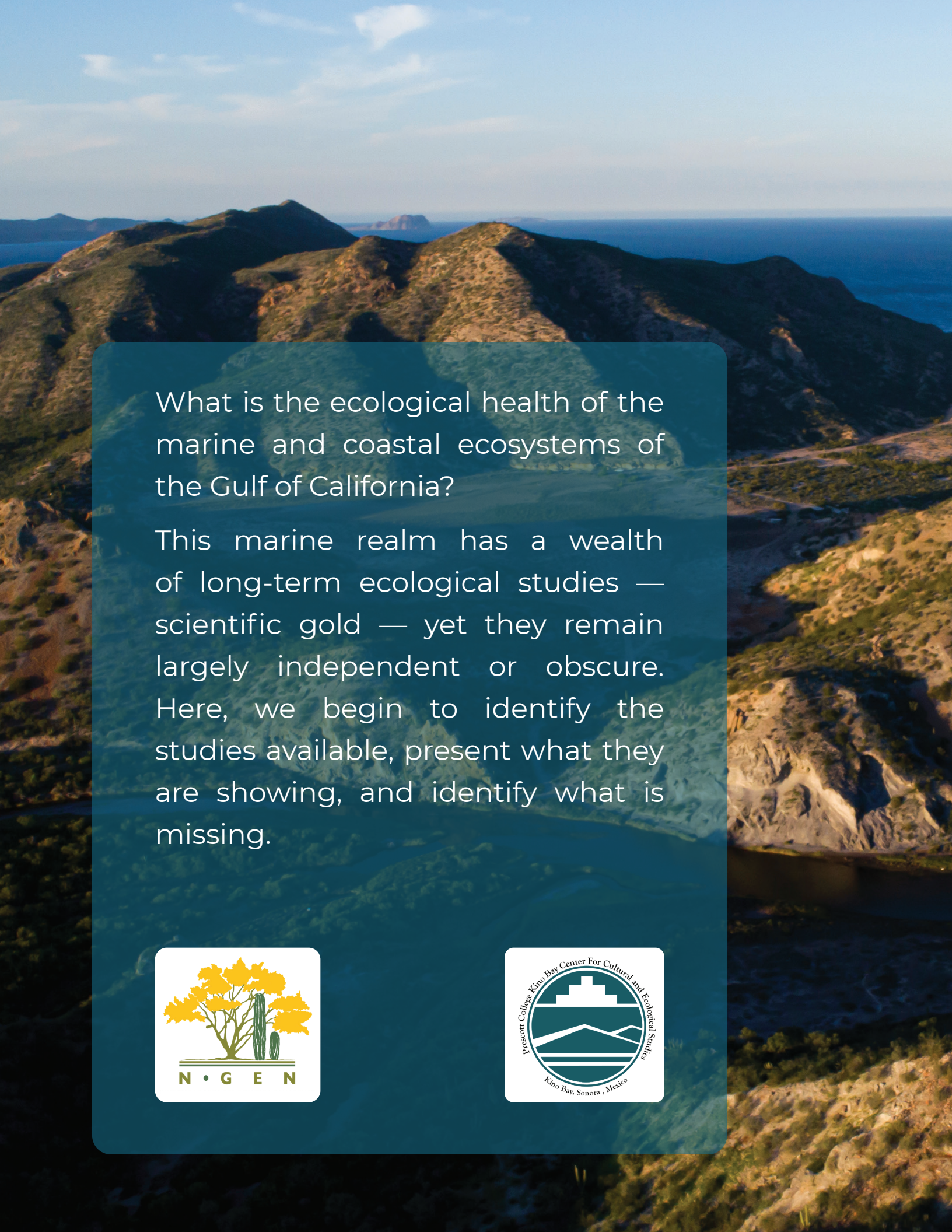

What is the ecological health of the marine and coastal ecosystems of the Gulf of California?

This marine realm has a wealth of long-term ecological studies — scientific gold — yet they remain largely independent or obscure. Here, we begin to identify the studies available, present what they are showing, and identify what is missing.

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