TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

Transboundary Waters: A Global Compendium

Water System Information Sheets: Central America & Caribbean

Volume 6 - Annex B: Central America & Caribbean

UNEP

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Volume 6-Annex B

Transboundary Waters: A Global Compendium

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MINISTRY FOR FOREIGN AFFAIRS OF FINLAND

Acknowledgements

Assessment Team: Transboundary Aquifers

UNESCO
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme

igrac
International Groundwater Resources Assessment Centre

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

SFU SIMON FRASER UNIVERSITY ENGAGING THE WORLD

Assessment Team: Transboundary Lake Basins & Reservoirs

ILEC

The Meadows Center for Water and the Environment
TEXAS STATE UNIVERSITY

SHIGA UNIVERSITY

Assessment Team: Transboundary River Basins

UNEP-DHI PARTNERSHIP
Centre on Water and Environment
UNEP DHI

GLOBAL IGBP CHANGE International Geosphere-Biosphere Programme

IUCN

SIWI

CUNY The City University of New York

OSU Oregon State University

Center for International Earth Science Information Network
Earth Institute | Columbia University

CESR Center for Environmental Systems Research

DeltAlliance

Assessment Team: Large Marine Ecosystems

UNESCO
United Nations Educational, Scientific and Cultural Organization
Intergovernmental Oceanographic Commission

GLOBAL IGBP CHANGE International Geosphere-Biosphere Programme

NOAA

GESAMP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

DALHOUSIE UNIVERSITY Inspiring Minds

Center for Marine Assessment and Planning, UCSB

UNEP WCMC

CERMES

UBC

SEA AROUND US

TAT
Tokyo University of Agriculture and Technology

Assessment Team: The Open Ocean

UNESCO
United Nations Educational, Scientific and Cultural Organization
Intergovernmental Oceanographic Commission

GOOS Global Ocean Observing System

WCRP World Climate Research Programme

GACS Global Alliance of CPR Surveys

PML Plymouth Marine Laboratory

CERMES

UBC

SEA AROUND US

Center for Marine Assessment and Planning, UCSB

GESAMP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

DALHOUSIE UNIVERSITY Inspiring Minds

Project Coordinating Unit: Transboundary Waters Assessment Programme

UNEP

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MINISTRY FOR FOREIGN AFFAIRS OF FINLAND

Compendium Editor: **Liana Talaue McManus,** TWAP Project Manager

Lead Authors, Crosscutting Analysis (Volume 6): **Liana Talaue McManus** (TWAP Project Manager), **Robin Mahon** (Centre for Resource Management and Environmental Studies, University of the West Indies, Barbados) (Co-Chairs, TWAP Crosscutting Analysis Working Group).

Members, Crosscutting Analysis Working Group:

Name, TWAP Component	Primary affiliation
Alice Aureli, *Aquifers Component Principal*	UNESCO International Hydrologic Programme (IHP), Paris, France
Leszek Bialy, *Aquifers (Former) Component Coordinator*	UNESCO International Hydrologic Programme (IHP), Paris, France
Julian Barbiére, *Large Marine Ecosystems (LMEs) Component Principal*	UNESCO Intergovernmental Oceanographic Commission, Paris, France
Maija Bertule, *Rivers Component*	UNEP-DHI Partnership Centre on Water and Environment, Denmark
Emanuele Bigagli, *Open Ocean Component*	UNESCO Intergovernmental Oceanographic Commission, Paris, France
Peter Bjørnsen, *Rivers Principal*	UNEP-DHI Partnership Centre on Water and Environment, Denmark
Bruno Combal, *LMEs and Open Ocean Components*	UNESCO Intergovernmental Oceanographic Commission, Paris, France
Aurélien Dumont, *Aquifers Component*	UNESCO International Hydrologic Programme (IHP), Paris, France
Lucia Fanning, *Co-Chair Governance Crosscutting Working Group*	Marine Affairs Program, Dalhousie University, Canada
Albert Fischer, *Principal* and *(Current) Open Ocean Component Coordinator*	UNESCO Intergovernmental Oceanographic Commission
Paul Glennie, *Rivers Component Coordinator*	UNEP-DHI Partnership Centre on Water and Environment, Denmark
Sarah Grimes, *(Former) Open Ocean Component Coordinator*	University of Geneva
Sherry Heileman, *LMEs Component Coordinator*	UNESCO Intergovernmental Oceanographic Commission, Paris, France
Pierre Lacroix, *Data and Information and Crosscutting Working Group*	University of Geneva
Matthew Lagod, *(Current) Aquifers Component Coordinator*	UNESCO International Hydrologic Programme (IHP), Paris, France
Masahisa Nakamura, *Lakes Component*	Research Center for Sustainability and Environment, Shiga University, Japan
Geert-Jan Nijsten, *Aquifers Component*	International Groundwater Centre (IGRAC)
Walter Rast, *Lakes Principal and Component Coordinator*	The Meadows Center for Water and the Environment, Texas State University, USA
Alex de Sherbinin, *Rivers Component*	Center for International Earth Science Information Network, Columbia University, New York, USA

Science communication: Nieves Izquierdo Lopes and Janet Skaalvik (GRID-ARENDAL)

UNEP Secretariat: Liana Talaue McManus (Project Manager), Joana Akrofi, Kaisa Uusimaa (UNEP/DEWA) and Isabelle van der Beck (Task Manager)

Design and layout: Audrey Ringler (UNEP), Jennifer Odallo (UNON), Paul Odhiambo (UNON)

GIS: Jane Muriithi (UNEP/DEWA)

Central Data Portal: Pierre Lacroix and Andrea de Bono (GRID-Geneva)

Administrative Boundaries: Source of administrative boundaries used throughout the assessment: The Global Administrative Unit Layers (GAUL) dataset, implemented by FAO within the CountrySTAT and Agricultural Market Information System (AMIS) projects.

Contents (Volume 6, Annex B)

Preface

The Global Environment Facility (GEF) approved a Full Size Project (FSP), "A Transboundary Waters Assessment Programme: Aquifers, Lake/Reservoir Basins, River Basins, Large Marine Ecosystems, and Open Ocean to catalyze sound environmental management", in December 2012, following the completion of the Medium Size Project (MSP) "Development of the Methodology and Arrangements for the GEF Transboundary Waters Assessment Programme" in 2011. The TWAP FSP started in 2013, focusing on two major objectives: (1) to carry out the first global-scale assessment of transboundary water systems that will assist the GEF and other international organizations to improve the setting of priorities for funding; and (2) to formalise the partnership with key institutions to ensure that transboundary considerations are incorporated in regular assessment programmes to provide continuing insights on the status and trends of transboundary water systems.

The TWAP FSP was implemented by UNEP as Implementing Agency, UNEP's Division of Early Warning and Assessment (DEWA) as Executing Agency, and the following lead agencies for each of the water system categories: the International Hydrological Programme (IHP) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) for transboundary aquifers including groundwater systems in small island developing states (SIDS); the International Lake Environment Committee Foundation (ILEC) for lake and reservoir basins; the UNEP-DHI Partnership – Centre on Water and Environment (UNEP-DHI) for river basins; and the Intergovernmental Oceanographic Commission (IOC) of UNESCO for large marine ecosystems (LMEs) and the open ocean.

The five water-category specific assessments cover 199 transboundary aquifers and groundwater systems in 43 small island developing states, 204 transboundary lakes and reservoirs, 286 transboundary river basins; 66 large marine ecosystems; and the open ocean, a total of 756 international water systems. The assessment results are organized into five technical reports and a sixth volume that provides a cross-category analysis of status and trends:

- Volume 1 – ***Transboundary Aquifers and Groundwater Systems of Small Island Developing States: Status and Trends***
- Volume 2 – ***Transboundary Lakes and Reservoirs: Status and Trends***
- Volume 3 – ***Transboundary River Basins: Status and Trends***
- Volume 4 – ***Large Marine Ecosystems: Status and Trends***
- Volume 5 – ***The Open Ocean: Status and Trends***
- Volume 6 – ***Transboundary Water Systems: Crosscutting Status and Trends***

A ***Summary for Policy Makers*** accompanies each volume.

Volume 6 presents a unique and first global overview of the contemporary risks that threaten international water systems in five transboundary water system categories, building on the detailed quantitative indicator-based assessment conducted for each water category. As a supplement to Volume 6, this global compendium of water system information sheets provides baseline relative risks at regional and system scales. The fact sheets are organized into 14 TWAP regions and presented as 12 annexes. Volume 6 and the compendium are published in collaboration among the five independent water-category based TWAP Assessment Teams under the leadership of the Cross-cutting Analysis Working Group, with support from the TWAP Project Coordinating Unit.

The technical teams of the Transboundary Waters Assessment Programme(TWAP) assessed transboundary aquifers, lakes & reservoirs, river basins, and large marine ecosystems and prepared information (fact) sheets for water systems that were evaluated. Each fact sheet provides basic geomorphological information and presents baseline values of quantitative indicators that were used to establish relative risk levels. The water system fact sheets are organized into 14 TWAP regions that were used in the Crosscutting Analysis described in Volume 6. The regional compilations are presented as 11 annexes (A-K) of a global compendium, combining Southern & Southeastern Asia into one annex (I), and the Pacific Island Countries, Australia & Antarctica into another (Annex K). Each annex highlights contemporary regional risks as well as water system-specific risks. The annexes are:

In the case of the open ocean, which is the largest transboundary water system of planet earth, selected quantitative indicator maps prepared by the Open Ocean Assessment Team, are compiled in Annex L to highlight the contemporaneous state of the global ocean.

All information sheets and indicator maps for the open ocean may be downloaded individually from the following websites:

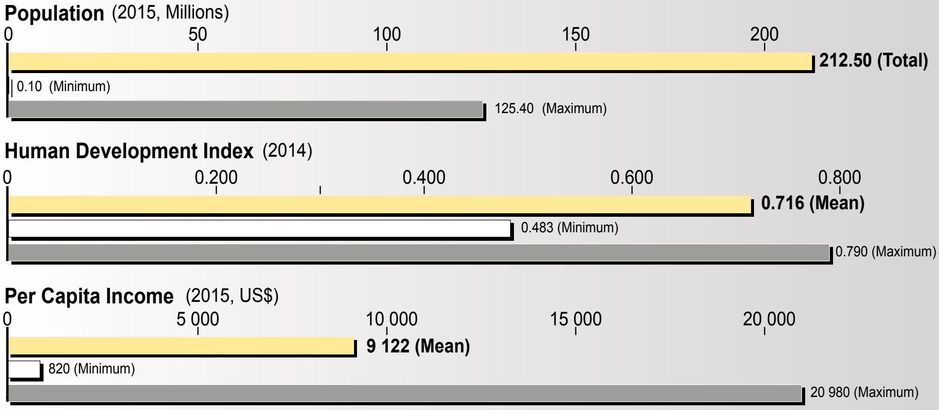
Transboundary Aquifers: http://twapviewer.un-igrac.org
Transboundary Lakes/ Reservoirs: http://ilec.lakes-sys.com/
Transboundary River Basins: http://twap-rivers.org
Large Marine Ecosystems: http://onesharedocean.org
Open Ocean: http://onesharedocean.org

All TWAP publications are available for download at http://www.geftwap.org

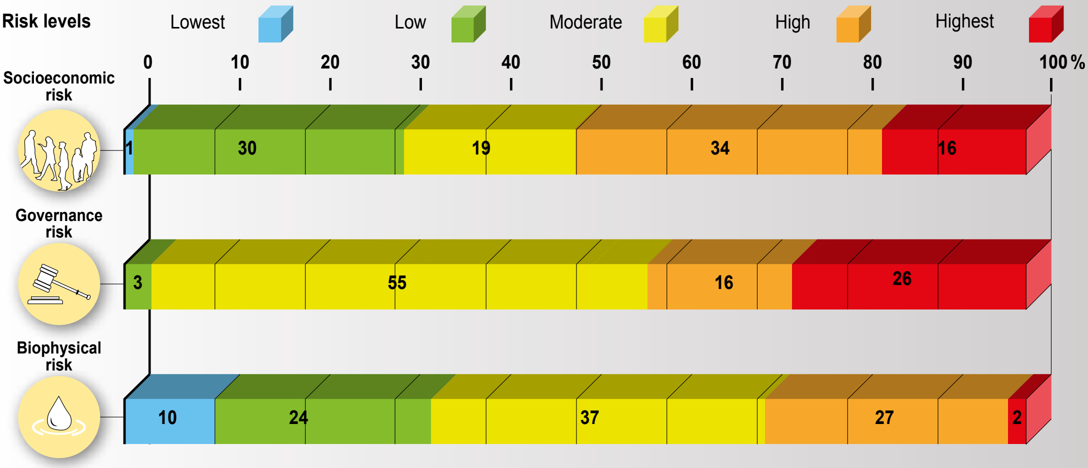
Over the long term, it is envisioned that these baseline information sheets will continue to be updated by future assessments at multiple spatial and temporal scales to better track the changing states of transboundary waters that are essential in sustaining human wellbeing and ecosystem health.

TRANSBOUNDARY WATERS: CENTRAL AMERICA & CARIBBEAN

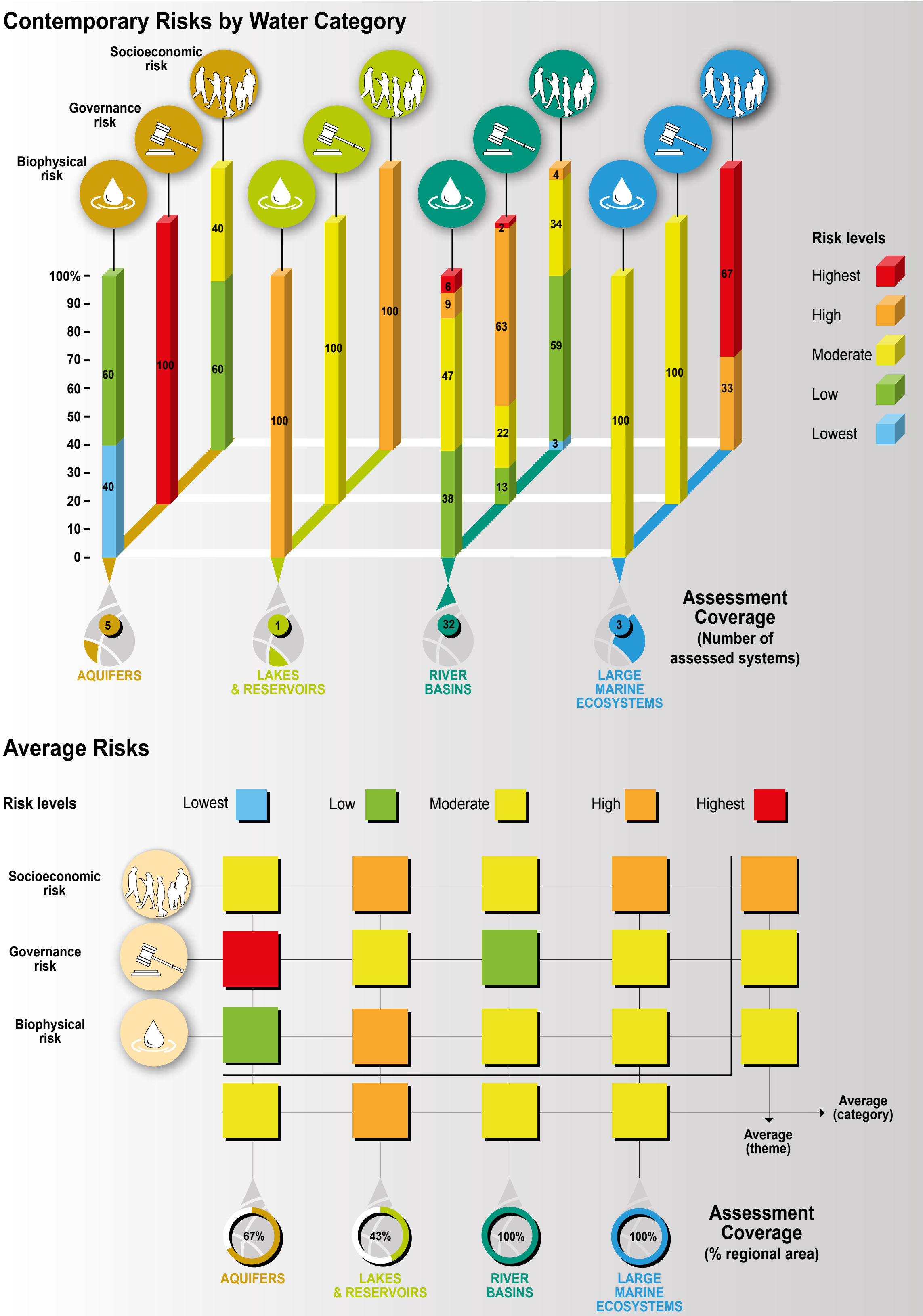
The region belongs to the High HDI group with a regional average HDI of 0.716, and a population reaching 212 million in 2015. Contemporary risks of water systems by water category and theme expressed as percentages are shown at top right. Across 41 transboundary waters in the region (bottom left), 50% experience high to highest socioeconomic risk; 97% are subject to moderate to highest governance risk; and 66% are threatened by moderate to highest biophysical risk. On average (bottom right), the region's transboundary waters are at high socioeconomic risk, and are at moderate governance and biophysical risks. Aquifers, river basins and LMEs are at moderate risk across risk themes, but lakes are at high risk.



Contemporary Risks by Theme



Regional Risks by Water Category



1. Cuenca Baja del Rio Bravo-Grande
2. Cuenca Baja del Rio Colorado
3. Edwards - Trinity - El Burro
4. Boca del Cerro-San Pedro
5. Ocosingo-Usumacinta-Pocóm-Ixcán
6. Soconusco-Suchiate/ Coatán
7. Esquipulas-Ocotepeque-Citalá
8. Península del Yucatán-Candelaria-Hondo

17N - Cuenca Baja del Rio Bravo-Grande

Geography

Total area TBA (km^2): 25 000

No. countries sharing: 2

Countries sharing: Mexico, United States of America

Population: 2 600 000

Climate zone: Semi-arid

Rainfall (mm/yr): 600

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Whole aquifer semi-confined

Main Lithology: Sediment - sand

No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

17N - Cuenca Baja del Rio Bravo-Grande

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Mexico	11	120	<5	100	0		95	15	A	C
United States of America							130			
TBA level							**100**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

TWAP Groundwater Indicators from WaterGAP model

	Recharge, incl. recharge from irrigation (mm/yr)	Renewable groundwater per capita			Human dependency on groundwater (%)	Human dependency on groundwater for domestic water supply (%)	Human dependency on groundwater for irrigation (%)	Human dependency on groundwater for industrial water use(%)
		Current state (m^3/y/capita)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)				
Mexico	92	1100	-14	-13	10	35	3	28
United States of America	160	1400	-19	-13	10	12	12	6
TBA level	**110**	**1200**	**-16**	**-13**	**10**	**26**	**6**	**14**

17N - Cuenca Baja del Rio Bravo-Grande

	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
Mexico	-1	83	19	29	8	6	9
United States of America	-1	110	16	26	7	4	3
TBA level	**-1**	**91**	**18**	**28**	**8**	**5**	**7**

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
Mexico	25	<5	150	Whole aquifer semi-confined	Sediment - Sand	High primary porosity fine/ medium sedimentary deposits	No secondary porosity	540
United States of America								
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

Only Mexico has provided information, so most of the information relates to the part of the aquifer within Mexico.

Aquifer geometry

It is a multiple 7-layered, hydraulically connected, system. The whole aquifer is semi-confined. The average distance of the groundwater level is 25m and average total vertical thickness of the aquifer system is 150m.

Hydrogeological aspects

The main lithology is sediment - sand. The material has high primary porosity fine/medium sedimentary deposits. The average aquifer transmissivity is estimated as 542m^2/d. The average annual aquifer recharge is estimated at 200 Mm^3/annum, coming from a recharge area of 540 km^2. The total groundwater volume is 21 km^3.

Linkages with other water systems

Recharge into the aquifer system is from precipitation on the aquifer area and discharge from the system is through evapotranspiration.

17N - Cuenca Baja del Rio Bravo-Grande

Environmental aspects
97% of groundwater across the aquifer area is unsuitable for human consumption as a result of elevated levels of natural salinity. Significant pollution has been identified, at this stage only in the surficial layers. The sources are landfills/waste disposal sites, households, agricultural practices and oil/gas production and transport activities. Observed contaminants are salinization, nitrogen species, and pesticides. There is 2% of aquifer area covered with shallow groundwater and with groundwater dependent ecosystems.

Socio-economic aspects
The annual average groundwater abstraction has been estimated as 26 Mm^3/annum, which is also the figure provided for total annual fresh water abstraction. There has been no groundwater depletion.

Legal and Institutional aspects
Mexico makes mention of a Bilateral Agreement with full scope. It also identifies its National Institution that has a full mandate and full capacity. Groundwater management is undertaken according to National law and regulations.

Priority issues
The large extent of unsuitable natural water quality for drinking purposes together with the significant amount of pollution makes this an important aspect on which to focus on and to protect further degradation of the water quality.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert
Roberto Aurelio Sención Aceves	Comisión Nacional del Agua	Mexico	roberto.sencion@conagua.gob.mx	Contributing national expert

Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

The TBA system could not be described fully, because only one of the two TBA countries provided adequate numerical information.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

17N - Cuenca Baja del Rio Bravo-Grande

Colophon

This Transboundary Aquifers information sheet has been produced as part of the Groundwater Component of the GEF Transboundary Water Assessment Programme (GEF TWAP). **GEF TWAP** is the first truly global comparative assessment of transboundary groundwater, lakes, rivers, large marine ecosystems and the open ocean. More information on TWAP can be found on: www.geftwap.org . **The Groundwater component** of TWAP carried out a global comparison of 199 transboundary aquifers and the groundwater systems of 41 Small Island Developing States. The data used to compile this transboundary aquifer information sheet has been made available by national and regional experts from countries involved in the TWAP Groundwater project. For aquifers larger than 20 000 km2 and which are not overlapping, additional data are available from modelling done by the Goethe University Frankfurt (Germany) as part of TWAP Groundwater. All data were compiled by UNESCO-IHP and the International Groundwater Resources Assessment Centre (IGRAC – UNESCO Category II Institute). Values given in the fact-sheet represent an approximate guide only and should not replace data obtained from recent local assessments. The editors of this information sheet are not responsible for the quality of the data.

For more information on TWAP Groundwater and for more data, please have a look at the TWAP Groundwater Information Management System which is accessible via www.twap.isarm.org or www.un-igrac.org.

Request:
If you have additional data or information about this transboundary aquifer that can improve the quality of this information sheet and the underlying database, please contact us via email at info@un-igrac.org. If appropriate, the information will be uploaded to the database of transboundary aquifers and will also be used in new versions of this information sheet.

References:
- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United Nations Food and Agriculture Programme - FAO, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid, Future Estimates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H42B8VZZ. Accessed Jan 2015.
- Rainfall: Average rainfall per TBA has been calculated based on the aquifer map and grid data for precipitation. Source precipitation data: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Grid data download from www.worldclim.org (2015): Data for current conditions (~1950-2000), ESRI grids, 30 arc seconds, Precipitation.
- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

Version: October 2015

9N - Cuenca Baja del Rio Colorado

Geography

Total area TBA (km^2): 16 000

No. countries sharing: 2

Countries sharing: Mexico, United States of America

Population: 710 000

Climate zone: Arid

Rainfall (mm/yr): 70

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Whole aquifer unconfined

Main Lithology: Sediment - Sand

No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Mexico	26	620	35	100	0	B	43	110	A	C
United States of America							44			
TBA level							**43**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
Mexico	22	<5	600	Whole aquifer unconfined	Sediment - Sand	High primary porosity fine/ medium sedimentary deposits	No secondary porosity	6400
United States of America								
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

9N - Cuenca Baja del Rio Colorado

Aquifer description

Only Mexico has provided information

Aquifer geometry
It is a multiple 2-layered, hydraulically connected, system. The whole aquifer unconfined. The distance to the groundwater level is 22m and the total vertical thickness of the aquifer system is 600m.

Hydrogeological aspects
The main lithology is sediment – sand that have a high primary porosity fine/ medium sedimentary deposits and no secondary porosity. The average aquifer transmissivity is estimated as 6 400 m^2/d. The average annual aquifer recharge is estimated at 240 Mm^3/annum coming from a recharge area of 860 km^2. Total groundwater volume is 100 km^3.

Linkages with other water systems
Recharge to the aquifer system is from precipitation over the aquifer area and discharge from the system is through submarine outflow.

Environmental aspects
Groundwater quality on 64 % of the aquifer area is unsuitable for human consumption. The problem of elevated salinity occurs only in the superficial layers. Some pollution has been identified, occurring only in superficial layers. The main origin is agricultural practices and the impact has been local salinization. No part of the aquifer contains shallow groundwater or groundwater dependent ecosystems.

Socio-economic aspects
The annual average groundwater abstraction has been estimated as 260Mm^3/annum, which is also the figure provided for total annual fresh water abstraction. There has been no groundwater depletion.

Legal and Institutional aspects
Mexico makes mention of a Bilateral Agreement with full scope. It also identifies its National Institution that has a full mandate and full capacity. Groundwater management is undertaken according to National law and regulations.

Emerging issues
Information is only available from one country. Noticeable is that the groundwater abstraction in Mexico is of the same order of magnitude as the average annual recharge to the aquifer in that country.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert

9N - Cuenca Baja del Rio Colorado

Name	Organisation	Country	E-mail	Role
Roberto Aurelio Sención Aceves	Comisión Nacional del Agua	Mexico	roberto.sencion@conagua.gob.mx	Contributing national expert
Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert

Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

The TBA system could not be described fully, because only one of the TBA countries provided adequate numerical information.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Colophon

This Transboundary Aquifers information sheet has been produced as part of the Groundwater Component of the GEF Transboundary Water Assessment Programme (GEF TWAP). **GEF TWAP** is the first truly global comparative assessment of transboundary groundwater, lakes, rivers, large marine ecosystems and the open ocean. More information on TWAP can be found on: www.geftwap.org . **The Groundwater component** of TWAP carried out a global comparison of 199 transboundary aquifers and the groundwater systems of 41 Small Island Developing States. The data used to compile this transboundary aquifer information sheet has been made available by national and regional experts from countries involved in the TWAP Groundwater project. For aquifers larger than 20 000 km2 and which are not overlapping, additional data are available from modelling done by the Goethe University Frankfurt (Germany) as part of TWAP Groundwater. All data were compiled by UNESCO-IHP and the International Groundwater Resources Assessment Centre (IGRAC – UNESCO Category II Institute). Values given in the fact-sheet represent an approximate guide only and should not replace data obtained from recent local assessments. The editors of this information sheet are not responsible for the quality of the data.

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References:
- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United Nations Food and Agriculture Programme - FAO, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid, Future Estimates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H42B8VZZ. Accessed Jan 2015.
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- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

Version: October 2015

16N - Edwards-Trinity-El Burro

Geography

Total area TBA (km^2): 110 000

No. countries sharing: 2

Countries sharing: Mexico, United States of America

Population: 460 000

Climate zone: Semi-arid

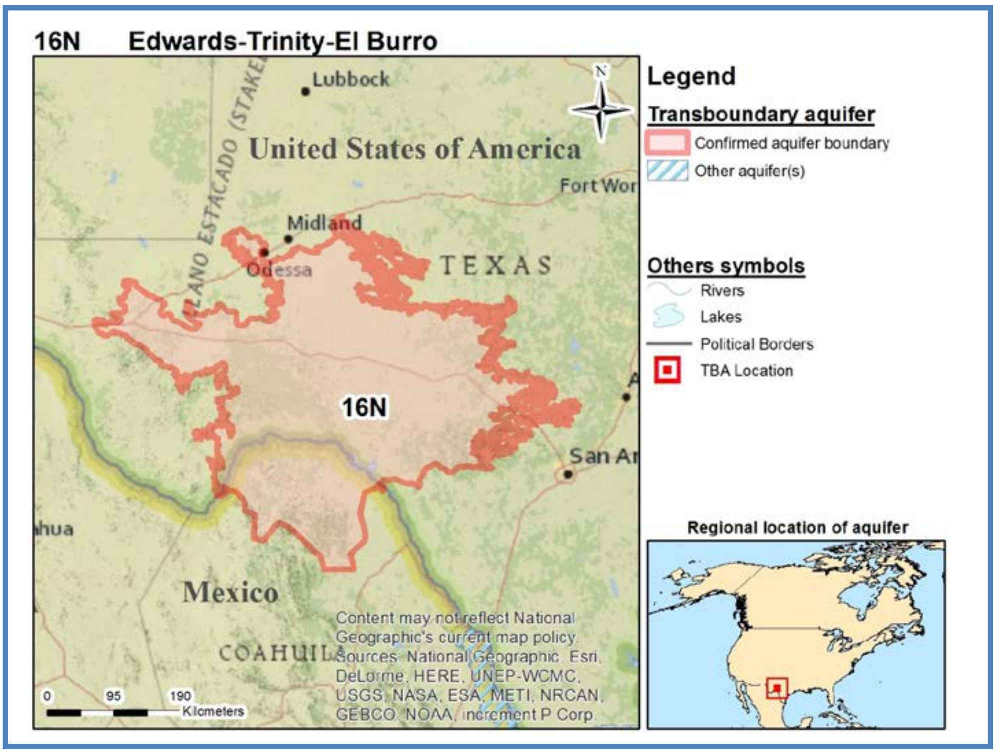
Rainfall (mm/yr): 460

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Whole aquifer unconfined

Main Lithology: Sedimentary rocks - Limestone



No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

16N - Edwards-Trinity-El Burro

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Mexico	1	66	100	100	0	A	9	5	A	C
United States of America							3			
TBA level							**4**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

TWAP Groundwater Indicators from WaterGAP model

	Recharge, incl. recharge from irrigation (mm/yr)	Renewable groundwater per capita			Human dependency on groundwater (%)	Human dependency on groundwater for domestic water supply (%)	Human dependency on groundwater for irrigation (%)	Human dependency on groundwater for industrial water use(%)
		Current state (m^3/y/capita)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)				
Mexico	6	700	-2	-6	25	39	19	0
United States of America	18	4300	-24	-24	63	70	79	6
TBA level	**16**	**3200**	**-24**	**-23**	**60**	**63**	**74**	**6**

16N - Edwards-Trinity-El Burro

	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
Mexico	0	8	20	30	14	6	14
United States of America	2	4	15	26	27	11	7
TBA level	**2**	**5**	**17**	**27**	**26**	**10**	**7**

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
Mexico	6	<5	80	Whole aquifer unconfined	Sedimentary rocks - Limestone	High primary porosity fine/ medium sedimentary deposits	Secondary porosity: Fractures	99
United States of America								
TBA level								

* Including aquitards/aquicludes
X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

Only Mexico has provided information

Aquifer geometry
It is a multiple 2-layered, hydraulically connected, system. The whole aquifer is unconfined. The average distance to the groundwater level is 6m and the average total vertical thickness of the aquifer system is 80m.

Hydrogeological aspects
The main lithology is sedimentary rocks - limestone that have a high primary porosity as well as secondary porosity: fractures. The average aquifer transmissivity is estimated at 99m²/d. The average annual aquifer recharge is estimated at 12 Mm³/annum, coming from a recharge area of 4 000 km². The total groundwater volume is 9 km³.

Linkages with other water systems
Recharge to the aquifer system is from precipitation on the aquifer area and discharge from the system is through evapotranspiration.

16N - Edwards-Trinity-El Burro

Environmental aspects
Groundwater across the whole aquifer area is suitable for human consumption. No pollution has been identified. No areas with shallow groundwater or groundwater dependent ecosystems have been reported by the countries, although the Edwards Aquifer is notably known for the groundwater dependent ecosystems that are located over its area.

Socio-economic aspects
The annual average groundwater abstraction has been estimated as 0.6 Mm^3/annum, which is also the figure provided for total annual fresh water abstraction. There has been no groundwater depletion.

Legal and Institutional aspects
Mexico makes mention of a Bilateral Agreement with full scope. It also identifies its National Institution that has a full mandate and full capacity. Groundwater management is undertaken according to National law and regulations.

Emerging issues
Nothing identified at this stage.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert
Roberto Aurelio Sención Aceves	Comisión Nacional del Agua	Mexico	roberto.sencion@conagua.gob.mx	Contributing national expert
Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert

Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

The TBA system could not be described fully, because only one of the TBA countries provided adequate numerical information.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

16N - Edwards-Trinity-El Burro

Colophon

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- All other data: TWAP Groundwater (2015).

Version: October 2015

5C - Boca del Cerro-San Pedro

Geography

Total area TBA (km^2): 21 000

No. countries sharing: 2

Countries sharing: Guatemala, Mexico

Population: 260 000

Climate zone: Tropical Wet

Rainfall (mm/yr): 1600

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Unconfined

Main Lithology: Karst rock and marine sediments

No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

5C - Boca del Cerro-San Pedro

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Guatemala							10			
Mexico	110	6400	100	100	0		17	<5	A	C
TBA level							**12**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).
(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.
(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).
(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.
(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).
(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).
X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

TWAP Groundwater Indicators from WaterGAP model

	Recharge, incl. recharge from irrigation (mm/yr)	Renewable groundwater per capita			Human dependency on groundwater (%)	Human dependency on groundwater for domestic water supply (%)	Human dependency on groundwater for irrigation (%)	Human dependency on groundwater for industrial water use(%)
		Current state (m^3/y/capita)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)				
Guatemala	210	21 000	-42	-63	51	57	21	11
Mexico	250	17 000	-27	-44	45	51	12	34
TBA level	**220**	**19 000**	**-36**	**-57**	**47**	**52**	**14**	**33**

	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
Guatemala	2	10	62	130	<1	0	1
Mexico	3	15	27	46	<1	1	1
TBA level	**2**	**12**	**46**	**91**	<1	**0**	**1**

5C - Boca del Cerro-San Pedro

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Primary Porosity	Secondary Porosity	Transmissivity (m^2/d)
Guatemala								
Mexico	X	X	260	Whole aquifer unconfined	Sediment - Sand	Low primary porosity intergranular porosity	Secondary porosity: Fractures	X
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

As most of the information was provided by Mexico, most of the values within this brief refer to the portion of the TBA within Mexico.

Aquifer geometry

It is a two layered, hydraulically connected aquifer system. The whole aquifer is unconfined, and shows levels of varying permeability, primary and secondary. Mexico reports an average vertical thickness of the aquifer system of 260 m.

Hydrogeological aspects

The aquifer system is located on limestone and dolomite with high degree of permeability by fracturing and development of extensive areas of karst circulation. In the middle and lower zones are terrigenous marine sediments, argillaceous limestone, sandstones and shales covered by recent sediments deposited in a continental environment. Groundwater recharge is very variable due to extreme recharge events. The mean annual groundwater recharge within Mexico is 790 Mm^3/annum over a recharge area of 2900 km^2. Its estimate of total groundwater volume is 38km^3.

Linkages with other water systems

Groundwater recharge is from precipitation over the aquifer area. The aquifer maintains base flow of rivers and riparian vegetation especially during periods of drought

Environmental Aspects

In some areas, the natural groundwater is characterized by its high content of sulphates and carbonates that make it unsuitable for human and animal consumption. There is no shallow groundwater and no pollution has been identified.

Socio-economic aspects

The aquifer supplies water to the populations of the central urban area of Peten (Guatemala) and the city of Tenosique. Groundwater abstraction in Mexico is estimated as 4.9 Mm^3/annum on average, compared to a total fresh water abstraction over the aquifer area of 6.3 Mm^3/annum.

Legal and Institutional

There is no common reporting here. Mexico makes mention of a signed Bi-lateral Agreement with full scope. Mexico also reports a dedicated national institution with full capacity for groundwater management.

5C - Boca del Cerro-San Pedro

Emerging issues
The issue at present appears to be water quality in some areas unsuitable for human and animal consumption.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert
Roberto Aurelio Sención Aceves	Comisión Nacional del Agua	Mexico	roberto.sencion@conagua.gob.mx	Contributing national expert

Considerations and recommendations

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The TBA system could not be described fully, because only one of the TBA countries provided some numerical information.

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- All other data: TWAP Groundwater (2015).

Version: October 2015

3C - Ocosingo-Usumacinta-Pocóm-Ixcán

Geography

Total area TBA (km^2): 21 000

No. countries sharing: 2

Countries sharing: Guatemala, Mexico

Population: 820 000

Climate zone: Tropical Wet

Rainfall (mm/yr): 2400

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Unconfined

Main Lithology: Karst rock

No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

3C - Ocosingo-Usumacinta-Pocóm-Ixcán

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Guatemala							64			
Mexico	300	11000	100	100	0		28	<5	A	C
TBA level							**39**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

TWAP Groundwater Indicators from WaterGAP model

	Recharge, incl. recharge from irrigation (mm/yr)	Renewable groundwater per capita			Human dependency on groundwater (%)	Human dependency on groundwater for domestic water supply (%)	Human dependency on groundwater for irrigation (%)	Human dependency on groundwater for industrial water use(%)
		Current state (m^3/y/capita)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)				
Guatemala	480	7600	-42	-62	42	46	8	36
Mexico	390	12 000	-25	-40	22	18	12	50
TBA level	**410**	**10 000**	**-34**	**-52**	**26**	**23**	**11**	**48**

	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
Guatemala	1	64	66	140	<1	0	2
Mexico	2	32	27	45	<1	0	1
TBA level	**2**	**41**	**44**	**85**	<1	**0**	**1**

3C - Ocosingo-Usumacinta-Pocóm-Ixcán

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Primary Porosity	Secondary Porosity	Transmissivity (m^2/d)
Guatemala								
Mexico	X	X	100	Whole aquifer unconfined	Sediment - Sand	Low primary porosity	Secondary porosity: Fractures	99
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

As most of the information was provided by Mexico, most of the values within this brief refer to the portion of the TBA within Mexico.

Aquifer geometry

It is a multiple 2-layered, hydraulically connected, unconfined aquifer system. Mexico reports an average vertical thickness of the aquifer system of 100 m.

Hydrogeological aspects

The aquifer consists of karstic rocks representing a complex underground circulation system associated with large cavities and fractures. It has a low primary porosity and secondary fracture porosity. Groundwater recharge is very variable due to extreme recharge events. Mexico reports an average transmissivity of 99 m^2/d and an average groundwater recharge, 100% natural, of 4 500 Mm^3/annum over an area of 15 000 km^2. Its estimate of the total groundwater volume is 77km^3.

Linkages with other water systems

Groundwater recharge is from precipitation on the aquifer. Groundwater flows from Guatemala into Mexico, and discharges into the Usumacinta River. The aquifer maintains the base flow of rivers and riparian vegetation especially during periods of drought.

Environmental Aspects

In some areas, the natural groundwater is characterized by its high content of sulphates and carbonates that make it unsuitable for human and animal consumption, but its extent was not specified. No anthropogenic pollution has been identified. It is estimated that 21% of the aquifer system within Mexico is characterised by shallow groundwater while 21% of the aquifer area is covered by groundwater dependent ecosystems.

Socio-economic aspects

Groundwater has relatively low importance, because the water levels are deep. The aquifer supplies the rural population that uses water for domestic and livestock purposes. It was estimate that the total amount of groundwater that was abstracted from the system during 2010 was 2.5 Mm^3.

Legal and Institutional

There is no common reporting under this point. Mexico makes mention of a signed Bi-lateral Agreement with full scope. It also reports a National Institution with full mandate and full capacity.

3C - Ocosingo-Usumacinta-Pocóm-Ixcán

Priority issues

Access to the relatively deep groundwater and unsuitability of the water in some areas is probably the priority issue at this stage.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert
Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert
Roberto Aurelio Sención Aceves	Comisión Nacional del Agua	Mexico	roberto.sencion@conagua.gob.mx	Contributing national expert

Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

The TBA system could not be described fully, because only one of the TBA countries provided adequate numerical information.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Colophon

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For more information on TWAP Groundwater and for more data, please have a look at the TWAP Groundwater Information Management System which is accessible via www.twap.isarm.org or www.un-igrac.org.

Request:

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3C - Ocosingo-Usumacinta-Pocóm-Ixcán

References:

- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United Nations Food and Agriculture Programme - FAO, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid, Future Estimates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H42B8VZZ. Accessed Jan 2015.
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- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

Version: October 2015

1C - Soconusco-Suchiate/ Coatán

Geography

Total area TBA (km^2): 4400

No. countries sharing: 2

Countries sharing: Guatemala, Mexico

Population: 890 000

Climate zone: Tropical Dry

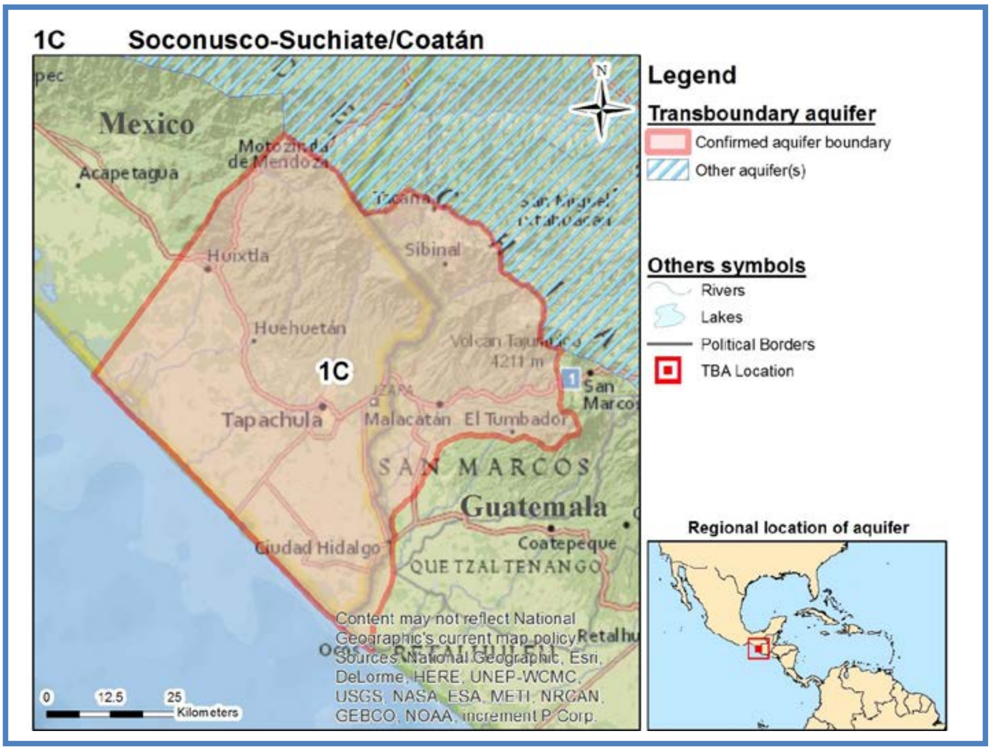
Rainfall (mm/yr): 2 700

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Unconfined

Main Lithology: Alluvial material



No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

1C - Soconusco-Suchiate/ Coatán

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Guatemala							230			
Mexico	300	1600	100	100	0	A	190	15	A	C
TBA level							**200**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).
(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.
(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).
(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.
(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).
(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).
X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Primary Porosity	Secondary Porosity	Transmissivity (m^2/d)
Guatemala								
Mexico	7	<5	<5	Whole aquifer unconfined	Sediment - Sand	High primary porosity fine/ medium sedimentary deposits	No secondary porosity	68
TBA level								

* Including aquitards/aquicludes
X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

1C - Soconusco-Suchiate/ Coatán

Aquifer description

As most of the information was provided by Mexico, most of the values within this Brief refer to the portion of the TBA within Mexico.

Aquifer geometry
The aquifer system is two-layered system and is totally unconfined (phreatic). The system appears to be shallow, with and the average depth to the groundwater level of 7m. The top of the aquifer protrudes to the surface and the average thickness of the aquifer system has not been recorded.

Hydrogeological aspects
It consists of alluvial materials of varying particle size, overlying crystalline (granites, diorites) and Tertiary volcanic rocks (basalts and andesites emitted by the volcano Tacaná). The material has a high primary porosity and no secondary porosity. It has a low horizontal and vertical connectivity and the average transmissivity value is $68m^2$/day. There is a significant difference between recharge events and the average annual recharge is estimated by Mexico as about 940 Mm^3/annum over a recharge area of around 3 100 km^2. The total groundwater volume is estimated as 15 km^3.

Linkages with other water systems
The recharge source, as reported by Mexico, is through precipitation on the aquifer and outflow to lakes is the discharge mechanism. In the upper portion, the groundwater flow is from Guatemala to Mexico, and in the lower portion there is virtually no groundwater movement across the international border.

Environmental aspects
The system is exposed to saline intrusion in the coastal portion and its quality has been impaired by agricultural activities and deposition of liquid and solid wastes. At present, the risk of significant transboundary impacts are minimal, although extreme weather events such as droughts, hurricanes and tropical storms can affect the quality and the availability of water. The characterization of shallow groundwater and groundwater dependent ecosystems within the system was not recorded.

Socio-economic aspects
The aquifer is a major source for agriculture in the lower part of the basin and for domestic-livestock uses, in its entirety. Mexico reports an annual groundwater abstraction of 160 Mm^3. The figure provided for the total fresh water abstraction is the same.

Legal and Institutional aspects
There is no common reporting here. Mexico makes mention of a signed Bi-lateral Agreement with full scope. It also reports a National Institution with full capacity for groundwater management.

Priority issues
The aquifer, which is already a major source for agricultural water supply and for domestic and livestock use, is impacted by pollution as well as seawater intrusion. National and bi-lateral management measures need to be put in place to sustain the multiple uses of the system.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert

1C - Soconusco-Suchiate/ Coatán

Name	Organisation	Country	E-mail	Role
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert
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M. C. Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert

Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.
The TBA could not be described fully, because only one of the two bordering countries provided information.
Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Colophon

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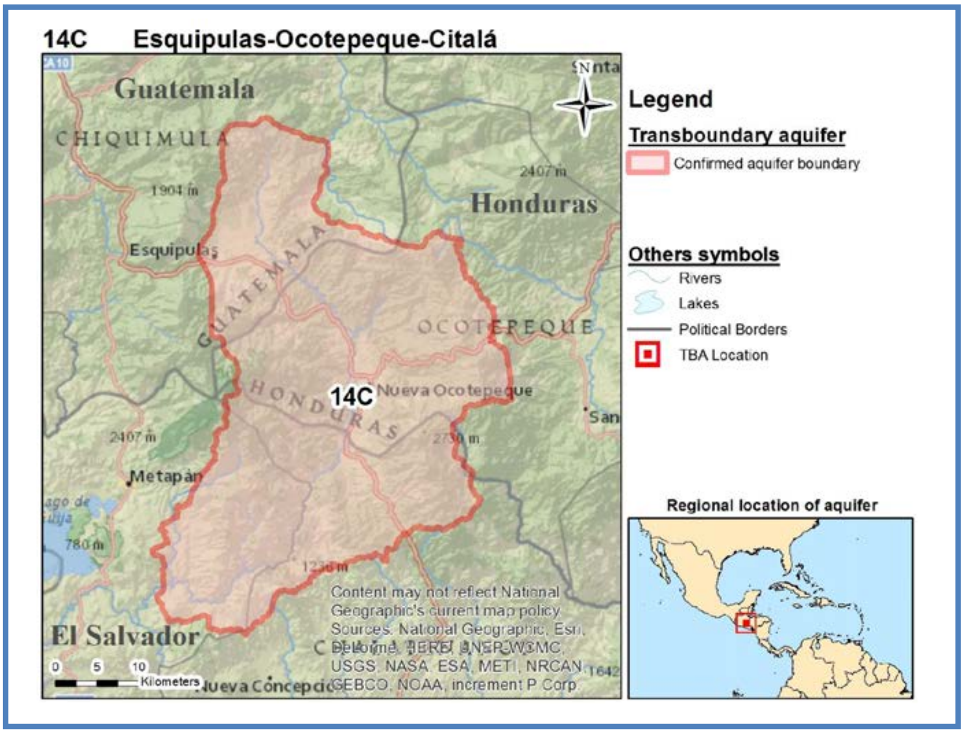
- All other data: TWAP Groundwater (2015).

Version: October 2015

14C - Esquipulas-Ocotepeque-Citalá

Geography
Total area TBA (km^2): 1400
No. countries sharing: 3
Countries sharing: El Salvador, Guatemala, Honduras
Population: 130 000
Climate zone: Highlands
Rainfall (mm/yr): 1600

Hydrogeology
Aquifer type: Multiple layers hydraulically connected
Degree of confinement: Mostly unconfined
Main Lithology: Sediment - Silt - Clay



No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

14C - Esquipulas-Ocotepeque-Citalá

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
El Salvador	84	920					92		A	D
Guatemala	200	1900	80	100			110	50		
Honduras							85			
TBA level							**93**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
El Salvador	12	40	80	Aquifer mostly unconfined, but some parts confined	Sediment - Silt - Clay	High primary porosity fine/ medium sedimentary deposits	Secondary porosity: Fractures	
Guatemala	8	7	65	Whole aquifer unconfined		High primary porosity fine/ medium sedimentary deposits	No secondary porosity	25
Honduras								

14C - Esquipulas-Ocotepeque-Citalá

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

Aquifer geometry

It is a multiple 2 to 3-layered, hydraulically connected aquifer system. The aquifer mostly unconfined, but in some parts confined. Average distance to groundwater level is 12m and depth to the top of the aquifer is 7m in Guatemala and 40m in El Salvador. El Salvador reports a vertical thickness of the aquifer system of 80 m.

Hydrogeological aspects

It consists of sedimentary deposits of Quaternary alluvial valleys, with a high primary porosity, in fine to medium grain sediments with a high horizontal connectivity. Only El Savador reports on secondary porosity: fractured. The total amount of groundwater volume within Guatemala is $0.72km^3$. The average transmissivity within Guatemala is $25m^2/d$. The average annual recharge, which is 100% due to natural recharge, within El Salvador and Guatemala is 100 Mm^3/annum. Extreme recharge events are known to occur within the area but this was not quantified.

Linkages with other water systems

Groundwater recharge is through precipitation over the aquifer area and the discharge mechanism is through springs and river base flow.

Environmental Aspects

About 20% of the natural groundwater quality within Guatemala is unsuitable for drinking water but the reasons have not been recorded. Some anthropogenic contamination, resulting in high coliform bacteria counts, has been identified in the superficial layers of the aquifer. 75% of the aquifer area in Guatemala has shallow groundwater and 20% of the area has groundwater dependent ecosystems.

Socio-economic aspects

The primary use is domestic and agricultural. Guatemala reports annual groundwater abstraction as 11 Mm^3/annum, compared to a total fresh water abstraction of 28 Mm^3/annum.

Legal and Institutional aspects

There is a specific Multi-lateral legal agreement with full scope between the countries - the Commision Trinacional del Plan Trifinio, 1997. Only El Salvador reports on its National Institution which still has a limited mandate and capacity for groundwater management.

Emerging issues

The alluvial aquifer is vulnerable to pollution and all three countries need to initiate water quality monitoring and where necessary, pollution control measures.

14C - Esquipulas-Ocotepeque-Citalá

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Dagoberto Arévalo Herrera	Administración Nacional de Acueductos y Alcantarillados	El Salvador	Dagoberto.Arevalo@anda.gob.sv	Contributing national expert
Laura Beatriz Gil Urrutia	Ministerio de Medio Ambiente y Recursos Naturales	El Salvador	lgil@marn.gob.sv	Lead National Expert
Laura Beatriz Fulgencio Garavito	INSIVUMEH	Guatemala	fulga2000@hotmail.com	Lead National Expert
Gil Urrutia	Ministerio de Medio Ambiente y Recursos Naturales	El Salvador	lgil@marn.gob.sv	Contributing national expert
Wendy Carolina Rodriguez Molina	Secretaria deRecursos Naturales y Ambiente	Honduras	wcarolinarm@gmail.com	Contributing national expert

Considerations and recommendations

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A reasonable description of the aquifer system was possible from the data provided by two of the three TBA countries. Calculation of TBA indicators was not possible.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

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14C - Esquipulas-Ocotepeque-Citalá

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- All other data: TWAP Groundwater (2015).

Version: October 2015

7C - Península del Yucatán – Candelaria-Hondo

Geography

Total area TBA (km^2): 140 000

No. countries sharing: 3

Countries sharing: Belize, Guatemala, Mexico

Population: 3 800 000

Climate zone: Tropical Wet

Rainfall (mm/yr): 1200

Hydrogeology

Aquifer type: Multiple layers hydraulically connected

Degree of confinement: Unconfined

Main Lithology: Karst rock, sediment - sand

No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

7C - Península del Yucatán – Candelaria-Hondo

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Belize							12			
Guatemala							10			
Mexico	170	5900	100	100	0		28	10	A	C
TBA level							**28**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

TWAP Groundwater Indicators from WaterGAP model

	Recharge, incl. recharge from irrigation (mm/yr)	Renewable groundwater per capita			Human dependency on groundwater (%)	Human dependency on groundwater for domestic water supply (%)	Human dependency on groundwater for irrigation (%)	Human dependency on groundwater for industrial water use(%)
		Current state (m^3/y/capita)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)				
Belize	210	16 000	-37	-55	27	61	54	0
Guatemala	150	16 000	-37	-59	56	63	13	0
Mexico	110	3700	-26	-38	80	98	70	45
TBA level	**110**	**3900**	**-26**	**-39**	**79**	**98**	**70**	**45**

7C - Península del Yucatán – Candelaria-Hondo

	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
Belize	3	13	4	88	<1	0	1
Guatemala	1	10	53	100	<1	0	1
Mexico	3	29	21	31	5	7	14
TBA level	**3**	**28**	**21**	**32**	**4**	**7**	**13**

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
Belize								
Guatemala								
Mexico	7	<5	50	Whole aquifer unconfined	Sediment - Sand	High primary porosity fine/ medium sedimentary deposits	Secondary porosity: Dissolution	X
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

Aquifer geometry

It is a multiple layered, hydraulically connected, aquifer system and the whole aquifer is unconfined. It is a shallow system, with an average distance to the groundwater of 7m. The average vertical thickness of the aquifer system is 50m as reported for Mexico.

Hydrogeological aspects

The aquifer consists of sediment – sand within Mexico and sedimentary rocks – limestone within Belize. It has a high primary porosity and high secondary porosity, associated with dissolution cavities, where they have developed complex systems of underground circulation. The total groundwater volume within Mexico has been estimated as 350 km^3.It has been calculated that the mean annual groundwater recharge within the Mexico part of the aquifer, that is 100% due to natural recharge, is 22 000 Mm^3/annum.

Linkages with other water systems

Groundwater recharge is from precipitation on the aquifer area. The main mechanism of aquifer discharge is indicated as evapotranspiration.

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Environmental Aspects

With regard to the natural water quality some areas have higher amounts of natural salinity while high concentrations of sulphates, not suitable for human consumption and livestock, also occur within some areas but the extent has not been quantified. The aquifer is vulnerable to anthropogenic pollution (landfills and waste disposal) because the karst terrain has high infiltration capacity and virtually no ability to attenuate pollutants; however the abundant and rapid recharging water circulation promotes the dissolution and transport of contaminants, especially during heavy rains associated with hurricanes and tropical storms. Belize has reported on some pollution due to landfills and waste disposal sites that has led to some salinisation and high nitrates but no pollution has been detected within Mexico. No information has been recorded on shallow groundwater and groundwater dependent ecosystems.

Socio-economic aspects

The aquifer system is the primary source of water for the rural population. Mexico estimates groundwater abstraction as 700 Mm^3/annum and the total fresh water abstraction as 2 265Mm^3/annum.

Legal and Institutional

There is no common reporting under this point. Mexico makes mention of a signed bi-lateral agreement with full scope. Mexico itself has a national groundwater institution with full capacity and impact on groundwater resources management.

Priority issues

Natural water in places is unsuitable for human consumption as well as the pollution potential of the shallow Karst aquifer are priority issues at this stage.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Alberto Manganelli		Uruguay	albertomanganelli@yahoo.com	Regional coordinator
Tennielle Williams	Ministry of Natural Resources and Agriculture	Belize	policy.publicliaison@mnra.gov.bz	Lead National Expert
Rudolph Williams	Public Utilities Commission	Belize	rudolph_williams@hotmail.com	Contributing national expert
Víctor Manuel Castañón Arcos	Comisión Nacional del Agua	Mexico	victor.castanon@conagua.gob.mx	Contributing national expert
Rubén Chávez Guillén	Comisión Nacional del Agua	Mexico	ruben.chavez@conagua.gob.mx	Contributing national expert
Felipe Ignacio Arreguín Cortés	Comisión Nacional del Agua	Mexico	felipe.arreguin@conagua.gob.mx	Lead National Expert
Carlos Gutiérrez Ojeda	Instituto Mexicano de Tecnología del Agua	Mexico	cgutierr@tlaloc.imta.mx	Contributing national expert
Manuel Martínez Morales	Instituto Mexicano de Tecnología del Agua	Mexico	manuelm@tlaloc.imta.mx	Contributing national expert
Roberto Aurelio Sención Aceves	Comisión Nacional del Agua	Mexico	roberto.sencion@conagua.gob.mx	Contributing national expert

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Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

The TBA system could not be described fully, because only one of the three TBA countries provided adequate numerical information.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Colophon

This Transboundary Aquifers information sheet has been produced as part of the Groundwater Component of the GEF Transboundary Water Assessment Programme (GEF TWAP). **GEF TWAP** is the first truly global comparative assessment of transboundary groundwater, lakes, rivers, large marine ecosystems and the open ocean. More information on TWAP can be found on: www.geftwap.org . **The Groundwater component** of TWAP carried out a global comparison of 199 transboundary aquifers and the groundwater systems of 41 Small Island Developing States. The data used to compile this transboundary aquifer information sheet has been made available by national and regional experts from countries involved in the TWAP Groundwater project. For aquifers larger than 20 000 km2 and which are not overlapping, additional data are available from modelling done by the Goethe University Frankfurt (Germany) as part of TWAP Groundwater. All data were compiled by UNESCO-IHP and the International Groundwater Resources Assessment Centre (IGRAC – UNESCO Category II Institute). Values given in the fact-sheet represent an approximate guide only and should not replace data obtained from recent local assessments. The editors of this information sheet are not responsible for the quality of the data.

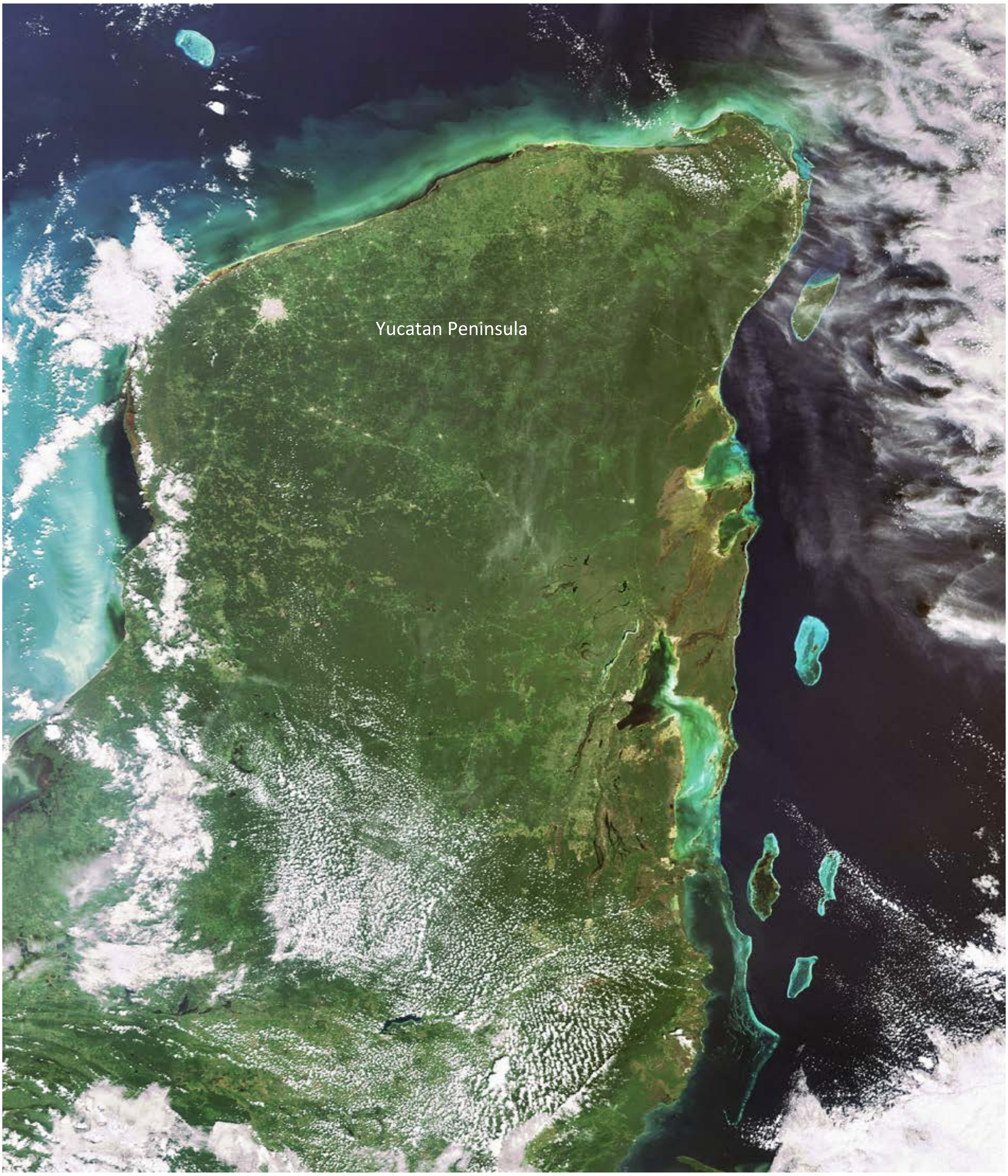
For more information on TWAP Groundwater and for more data, please have a look at the TWAP Groundwater Information Management System which is accessible via www.twap.isarm.org or www.un-igrac.org.

Request:
If you have additional data or information about this transboundary aquifer that can improve the quality of this information sheet and the underlying database, please contact us via email at info@un-igrac.org. If appropriate, the information will be uploaded to the database of transboundary aquifers and will also be used in new versions of this information sheet.

References:

- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United Nations Food and Agriculture Programme - FAO, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid, Future Estimates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H42B8VZZ. Accessed Jan 2015.
- Rainfall: Average rainfall per TBA has been calculated based on the aquifer map and grid data for precipitation. Source precipitation data: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Grid data download from www.worldclim.org (2015): Data for current conditions (~1950-2000), ESRI grids, 30 arc seconds, Precipitation.
- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

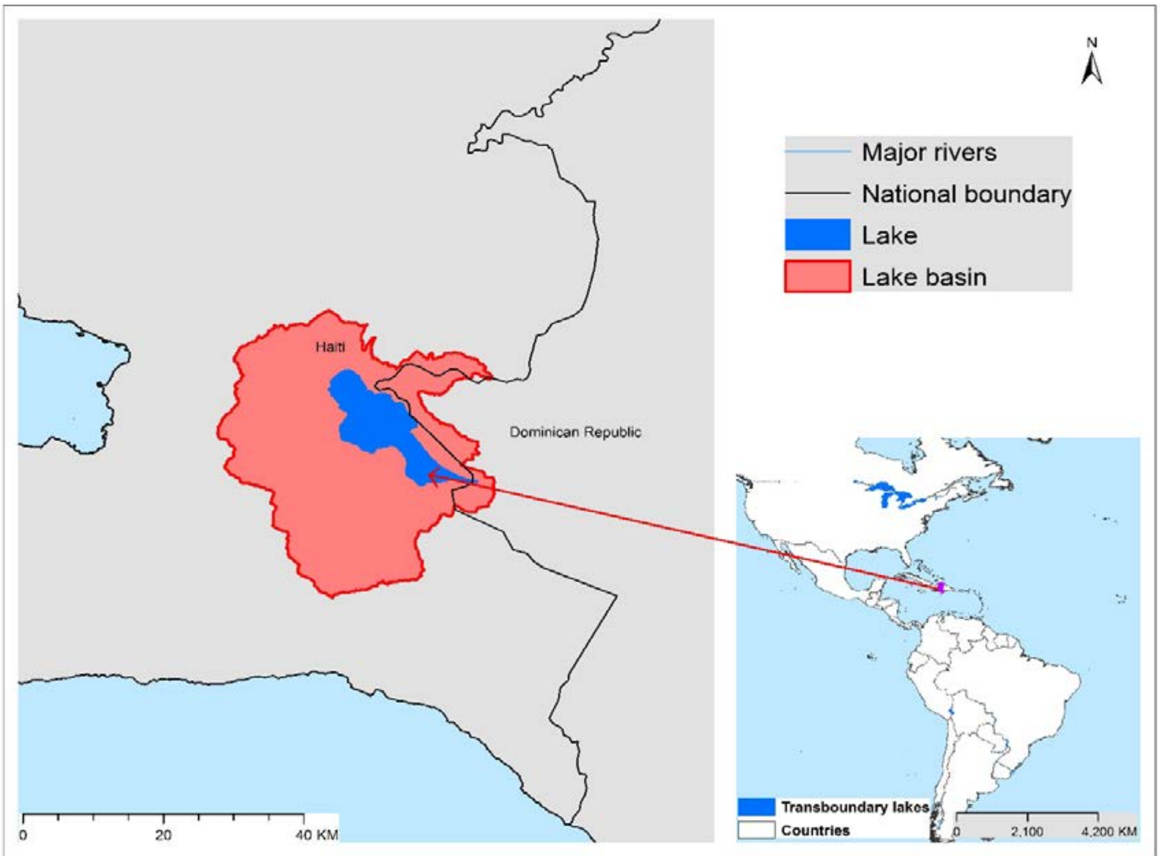
Version: October 2015


Yucatan Peninsula

1. Azuei

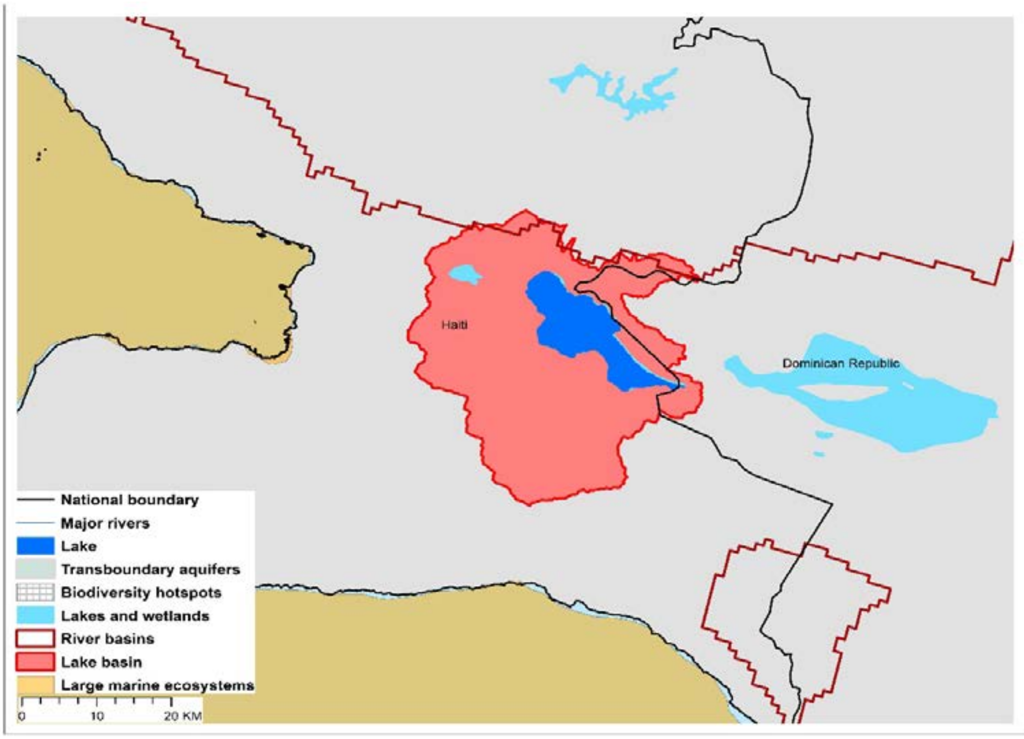
Lake Azuei — Geographic Information

Lake Azuei is the largest lake in Haiti and the second largest lake in Hispaniola after nearby Lake Enriquillo (which has itself become the first Dominican Ramsar Site). It is a terminal lake fed by springs and small streams draining into it from the surrounding area. It also is a degraded transboundary lake between Haiti and the Dominican Republic, being part of a chain of nearby saline lakes lying in the Hispaniolan Rift Valley. The area is experiencing highly-depressed economic conditions, and has only been slightly considered from the perspective of conservation and ecotourism in general. Lakes Azuei and Enriquillo are in the same region and become one waterbody during high rainfall years. The viability of possible GEF-catalyzed management interventions depends on many factors, including the potential economic and social development gains in this region from such interventions.

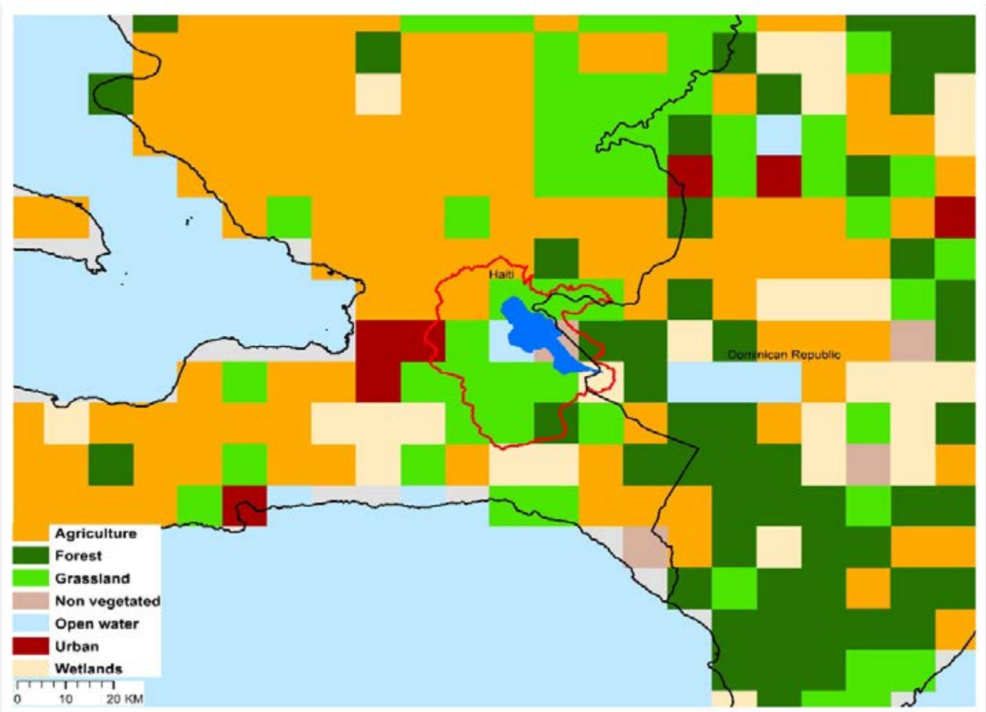


TWAP Regional Designation	Central America & Caribbean	**Lake Basin Population (2010)**	205,664
River Basin	Receives inflows from springs and small streams around the lake	**Lake Basin Population Density (2010; # km^{-2})**	184.0
Riparian Countries	Dominican Republic, Haiti	**Average Basin Precipitation (mm yr^{-1})**	1,232
Basin Area (km^2)	844.8	**Shoreline Length (km)**	60.9
Lake Area (km^2)	117.3	**Human Development Index (HDI)**	0.46
Lake Area:Lake Basin Ratio	0.118	**International Treaties/Agreements Identifying Lake**	No

Lake Azuei Basin Characteristics



(a) Lake Azuei basin and associated transboundary water systems



(b) Lake Azuei basin land use

Lake Azuei Threat Ranking

A serious lack of global-scale uniform data on the TWAP transboundary in-lake conditions required their potential threat risks be estimated on the basis of the characteristics of their drainage basins, rather than in-lake conditions. Using basin characteristics to rank transboundary lake threats precludes consideration of the unique features that can buffer their in-lake responses to basin-derived disturbances, including an integrating nature for all inputs, long water retention times, and complex, non-linear response dynamics.

The lake threat ranks were calculated with a spreadsheet-based interactive scenario analysis program, incorporating data and information about the nature and magnitude of their basin-derived stresses, and their possible impacts on the sustainability of their ecosystem services. These descriptive data for Lake Azuei and the other transboundary lakes included lake and basin areas, population numbers and densities, areal extent of basin stressors on the lake, data grid size, and other components considered important from the perspective of the user of the data results. The scenario analysis program also provides a means to define the appropriate context and preconditions for interpreting the ranking results.

The Lake Azuei threat ranks are expressed in terms of the Adjusted Human Water Security (Adj-HWS) threats, Reverse Biodiversity (RvBD) threats, and the Human Development Index (HDI) score, as well as combinations of these indices. However, it is emphasized that, being based on specific characteristics and assumptions regarding Lake Azuei and its basin characteristics, the calculated threat scores represent only one possible set of lake threat rankings. Defining the appropriate context and preconditions for interpreting the lake rankings remains an important responsibility of those using the threat ranking results, including lake managers and decision-makers.

Table 1. Lake Azuei Relative Threat Ranks, Based on Adjusted Human Water Security (Adj-HWS) and Reverse Biodiversity Threats, and Human Development Index (HDI) Score

(Estimated risks: red – highest; orange – moderately high; yellow – medium; green – moderately low; blue – low)

Adjusted Human Water Security (Adj-HWS) Threat Score	Relative Adj-HWS Threat Rank		Reverse Biodiversity (RvBD) Threat Score	Relative RvBD Threat Rank		Human Development Index (HDI) Score	Relative HDI Rank
0.96	3		0.57	31		0.46	21

It is emphasized that the Lake Azuei rankings above are discussed here within the context of the management and decision-making process, rather than as strict numerical ranks. Based on its geographic, population and socioeconomic assumptions used in the scenario analysis program, the calculated Adj-HWS score for Lake Azuei indicates a high threat rank compared to other priority transboundary lakes, a common situation for transboundary lakes in many developing countries.

The Reverse Biodiversity (RvBD) for Lake Azuei, which is meant to describe its biodiversity sensitivity to basin-derived degradation, places the lake in a medium threat rank, compared to the other transboundary lakes. Management interventions directed to improving the biodiversity status must be viewed with caution, however, since we lack sufficient knowledge and experience to accurately predict the ultimate impacts of biodiversity manipulations and preservation efforts. Further, the RvBD scores indicate the relative sensitivity of a lake basin to human activities, and high threat scores *per se* do not necessarily justify management interventions. Such interventions may actually increase biodiversity degradation, noting that many developed countries have already fundamentally degraded their biodiversity because of economic development activities. Thus, activities undertaken to address the Adj-HWS threats may actually degrade the biodiversity status and resources, even if the health and socioeconomic conditions of the lake basin stakeholders are improved as a result of better conditions, thereby increasing stakeholder resource consumption.

The relative Human Development Index (HDI) places the Lake Azuei basin in a moderately high threat rank in regard to its health, educational and economic conditions.

Table 2. Lake Azuei Threat Ranks, Based on Multiple Ranking Criteria

(Scores for Adj-HWS, RvBD and HDI ranks are presented in Table 1; the ranks may differ in some cases because of rounding of tied threat scores; Estimated risks: red – highest; orange – moderately high; yellow – medium;
green – moderately low; blue – low)

Adj-HWS Rank	HDI Rank	RvBD Rank		Sum Adj-HWS + RvBD	Relative Threat Rank		Sum Adj-HWS + HDI	Relative Threat Rank		Sum Adj-HWS + RvBD + HDI	Overall Threat Rank
5	21	31		36	20		26	11		57	19

When multiple ranking criteria are considered together in the threat rank calculations, the Adj-HWS and HDI scores considered together place Lake Azuei in the upper quarter of the threat ranks. The relative threat decreases somewhat when the Adj-HWS and RvBD threats are considered together. Considering all three ranking criteria together, Lake Azuei exhibits an overall moderately high threat ranking.

Interactions between the ranking parameters for Lake Azuei indicate differing sensitivity to basin-derived stresses. Identifying potential management interventions needs for Lake Azuei must be considered on the basis of educated judgement and accurate representations of its situation. A fundamental question will be how can one decide a given management intervention will produce the greatest benefit(s) for the greatest number of people in the Lake Azuei basin? Accurate answers to such questions for Lake Azuei, and other transboundary lakes, will require a case-by-case assessment approach that considers the specific lake situation and the anticipated improvements from specific management interventions, as well as interactions with water systems to which the lake is linked.

METHODOLOGY AND CAVEATS REGARDING TRANSBOUNDARY LAKE THREAT RANKS

A serious lack of global-scale uniform data on the TWAP transboundary in-lake conditions required their potential risks be estimated on the basis of the characteristics of their drainage basins, rather than analysis of their in-lake conditions. The lake threat ranks were calculated with a scenario analysis program that allowed incorporation of specific assumptions and preconditions about the nature and magnitude of their basin-derived stresses, and their possible impacts on the sustainability of their ecosystem services, as defined by the user of the ranking results. Because the transboundary lake threat ranks are based on specific lake and basin assumptions, therefore, the calculated rankings represent only one possible set of lake rankings.

Using basin characteristics to rank transboundary lake threats precludes consideration of the unique features that can buffer their in-lake responses to basin-derived disturbances, including an integrating nature for all inputs, long water retention times, and complex, non-linear response dynamics. A global overview of river basin threats based on 23 basin-scale drivers under four thematic areas (catchment disturbance; pollution; water resource development; biotic factors) was modified for the transboundary lakes assessment. The driver weights were initially based on collective opinions of experts exhibiting a range of disciplinary expertise, subsequently being refined with inputs from lake scientists and managers participating in ILEC's 15th World Lake Conference.

A spreadsheet-based, interactive scenario analysis program was used to rank the transboundary lake threats. The lake basin characteristics were determined by superimposing the lake basins over the river basin grids, and scaling the driver data to lake basin scale. Selected basin drivers, weights and preconditions were used in the scenario analysis program to calculate the relative lake threat ranks, expressed in terms of the Incident (HWS) and Adjusted (Adj-HWS) Human Water Security and Incident Biodiversity (BD) threats.

The transboundary lake analyses incorporated several assumptions and preconditions. Small transboundary lakes (area <5 km^2), sparse basin populations (< 5 persons km^{-1}), or that were frozen over for major portions of the year (annual air temperature <5 ^{o}C), were eliminated from the analyses. The areal extent of the influences of the basin drivers was addressed with a sensitivity analysis that indicated an areal band of 100 km^2 around a lake, appropriately clipped for the surrounding basin, was a realistic upper boundary for the scenario analysis program. The river basin grid size was problematic in that some grids (30' grid [0.5^{o}]) were often larger than those of some transboundary lake basins, and about 10% of the transboundary lakes lacked driver data for some grids. Based on these considerations, a final list of 53 priority transboundary lakes was selected for the scenario analysis program calculations of relative threat scores.

Insights obtained from lake scientists and managers participating in the 15th World Lake Conference helped address some of these concerns. Region-specific lake questionnaires also were distributed in some cases, obtaining both quantitative and qualitative data regarding the transboundary lakes and their basins.

These various factors and concerns indicate the transboundary lake threat ranks must be considered within the context of the specific basin conditions and assumptions used to derive them, since they represent only one possible set of lake threat rankings. Other factors such as lake and basin area, basin population and density, regional location, per capita Gross National Income (GNI), and Human

Development Index (HDI) could produce markedly different ranking results. Defining the appropriate context and preconditions for interpreting the lake ranking results, a task beyond the scope of this analysis, remains an important responsibility of those using the results, including lake managers and decision-makers.

The calculated ranks of the priority transboundary lakes, based on the specific assumptions and preconditions regarding the lakes and their drainage basins, is expressed below in terms of Adjusted Human Water Security (Adj-HWS) threats, Reverse Biodiversity (RvBD) threats, and Human Development Index (HDI) status. The Incident Human Water Security (HWS) score would suggest the current threat ranks of the lakes. However, for identifying needed management interventions, the ability of the basin countries to undertake investments to reduce identified transboundary water threats (i.e., water supply stabilization, improved water services, etc.) is also a relevant factor. This ability is considered within the context of the Adj-HWS threat. Countries less able to make such investments, mainly developing countries, exhibited higher Adj-HWS threats. Thus, the Adj-HWS threat ranks provide a more realistic picture of the transboundary lakes most in need of catalytic funding for management interventions than those with lower Adj-HWS scores.

Our more limited knowledge and experience regarding the ultimate outcomes of ecosystem restoration and conservation activities precluded a BD metric identical to the Adj-HWS threat. The Adj-HWS threat rank is meant to identify the transboundary lakes in most need of management interventions from a water investment perspective. The native biodiversity of most developed countries, however, has already been largely degraded as a result of their economic development activities. Thus, the preservation of those ecosystems still exhibiting the most pristine or undisturbed conditions should be the major BD management intervention goal. To address this goal, a RvBD threat was developed as a BD surrogate to define relative BD threats. It was calculated as 1-BD score, with the resulting RvBD score indicating the relative 'pristineness' of a lake in regard to its biodiversity status. The higher RvBD scores calculated with this normalization procedure identify the transboundary lakes most likely to be sensitive to BD degradation and, therefore, the lakes most in need of management attention.

The Human Development Index (HDI) is a composite statistic used by the United Nations Development Programme (UNDP) to reflect the relative life expectancy, education level, and per capita income of a country. A country whose inhabitants exhibit longer life spans, higher education levels, and higher per capita GDPs typically exhibit higher HDI scores, suggesting a higher overall condition of its citizens. It is meant to indicate that economic growth alone is not the sole criteria to assessment of a country, but that the status of its citizens and their capabilities also are important defining factors, therefore being an indication of potential human development.

Along with the assumptions and preconditions defining specific lake basin characteristics, these three criteria were major indicators considered within the context of the scenario analysis program to calculate the relative threat ranks of the transboundary lakes, as presented in the transboundary lake profile sheets.

Transboundary Lakes Ranked on Basis of (a) Incident Human Water Security [HWS] Threats, (b) Adjusted Human Water Security [Adj-HWS] Threats, and (c) Incident Biodiversity [BD] Threats

(Cont., continent; Eur, Europe; N.Am, North America; Afr., Africa; S.Am, South America;
Estimated risks: red – highest; orange – moderately high; yellow – medium; green – moderately low; blue – low)

(A) Lakes Ranked on Basis of Adjusted Human Water Security (Adj-HWS) Threats

Lake	Cont.	Surface Area (km^2)	Adj-HWS Threat Score	Rank
Sistan	Asia	488.2	0.98	1
Ihema	Afr.	93.2	0.97	2
Azuei	S.Am	117.3	0.96	3
Rweru/Moero	Afr.	125.6	0.96	4
Cohoha	Afr.	64.8	0.96	5
Edward	Afr.	2232.0	0.94	6
Natron/Magadi	Afr.	560.4	0.93	7
Abbe/Abhe	Afr.	310.6	0.93	8
Victoria	Afr.	66841.5	0.91	9
Albert	Afr.	5502.3	0.91	10
Kivu	Afr.	2371.1	0.91	11
Malawi/Nyasa	Afr.	29429.2	0.91	12
Dead Sea	Eur	642.7	0.90	13
Turkana	Afr.	7439.2	0.90	14
Aras Su Qovsaginin Su Anbari	Asia	52.1	0.89	15
Mangla	Asia	85.4	0.87	16
Galilee	Eur	162.0	0.87	17
Darbandikhan	Asia	114.3	0.87	18
Selingue	Afr.	334.4	0.87	19
Shardara/Kara-Kul	Asia	746.1	0.86	20
Nasser/Aswan	Afr.	5362.7	0.86	21
Chilwa	Afr.	1084.2	0.86	22
Josini/Pongola-poort Dam	Afr.	128.6	0.85	23

(B) Lakes Ranked on Basis of Reverse Biodiversity (RvBD) Threats

Lake	Cont.	Surface area (km^2)	RvBD Threat Score	Rank
Lake Congo River	Afr.	306.0	0.80	1
Sarygamysh	Asia	3777.7	0.75	2
Chiuta	Afr.	143.3	0.74	3
Mweru	Afr.	5021.5	0.72	4
Aral Sea	Asia	23919.3	0.72	5
Tanganyika	Afr.	32685.5	0.71	6
Abbe/Abhe	Afr.	310.6	0.71	7
Titicaca	S.Am	7480.0	0.71	8
Chilwa	Afr.	1084.2	0.70	9
Salto Grande	S.Am	532.9	0.70	10
Turkana	Afr.	7439.2	0.70	11
Cahora Bassa	Afr.	4347.4	0.69	12
Chungarkkota	S.Am	52.6	0.69	13
Malawi/Nyasa	Afr.	29429.2	0.68	14
Nasser/Aswan	Afr.	5362.7	0.68	15
Selingue	Afr.	334.4	0.68	16
Kivu	Afr.	2371.1	0.67	17
Natron/Magadi	Afr.	560.4	0.67	18
Lago de Yacyreta	S.Am	1109.4	0.66	19
Kariba	Afr.	5258.6	0.66	20
Edward	Afr.	2232.0	0.65	21
Aby	Afr.	438.8	0.65	22
Chad	Afr.	1294.6	0.64	23

(C) Lakes Ranked on Basis of Human Development Index (HDI) Scores

Lake	Cont.	Surface area (km^2)	HDI Score	Rank
Lake Congo River	**Afr**	**306.0**	**0.34**	**1**
Selingue	**Afr**	**334.4**	**0.36**	**2**
Rweru/Moero	**Afr**	**125.6**	**0.36**	**3**
Cohoha	**Afr**	**64.8**	**0.38**	**4**
Kivu	**Afr**	**2371.1**	**0.38**	**5**
Mweru	**Afr**	**5021.5**	**0.38**	**6**
Abbe/Abhe	**Afr**	**310.6**	**0.40**	**7**
Tanganyika	**Afr**	**32685.5**	**0.40**	**8**
Turkana	**Afr**	**7439.2**	**0.41**	**9**
Chiuta	**Afr**	**143.3**	**0.41**	**10**
Chilwa	**Afr**	**1084.2**	**0.41**	**11**
Malawi/Nyasa	**Afr**	**29429.2**	**0.42**	**12**
Edward	**Afr**	**2232.0**	**0.43**	**13**
Nasser/Aswan	**Afr**	**5362.7**	**0.43**	**14**
Cahora Bassa	**Afr**	**4347.4**	**0.43**	**15**
Chad	**Afr**	**1294.6**	**0.43**	**16**
Kariba	**Afr**	**5358.6**	**0.43**	**17**
Ihema	**Afr**	**93.2**	**0.44**	**18**
Sistan	**Asia**	**488.2**	**0.46**	**19**
Albert	**Afr**	**5502.3**	**0.46**	**20**
Azuei	**S.Am,**	**117.3**	**0.46**	**21**
Victoria	**Afr**	**66841.5**	**0.47**	**22**
Natron/Magadi	**Afr**	**560.4**	**0.51**	**23**

	Afr.	143.3	0.85	24		Albert	Afr.	5502.3	0.63	24		**Aby**	**Afr**	**438.8**	**0.52**	**24**
Chad	Afr.	1294.6	0.84	25		Sistan	Asia	488.2	0.62	25		**Mangla**	**Asia**	**85.4**	**0.54**	**25**
Aral Sea	Asia	23919.3	0.84	26		Amistad	N.Am	131.3	0.61	26		**Aral Sea**		**23919.3**	**0.60**	**26**
Tanganyika	Afr.	32685.5	0.84	27		Caspian Sea	Asia	377543.2	0.60	27		**Josini/Pongola-poort Dam**	**Afr**	**128.6**	**0.61**	**27**
Aby	Afr.	438.8	0.83	28		Cohoha	Afr.	64.8	059	28		**Shardara/Kara-kul**	**Asia**	**746.1**	**0.65**	**28**
Cahul	Eur	89.0	0.82	29		Itaipu	S.Am	1154.1	0.58	29		**Sarygamysh**	**Asia**	**3777.7**	**0.67**	**29**
Chungarkkota	S.Am	52.6	0.82	30		Rweru/Moero	Afr.	125.6	0.58	30		**Darbandikhan**	**Asia**	**114.3**	**0.68**	**30**
Titicaca	S.Am	7480.0	0.82	31		Azuei	S.Am	117.3	0.57	31		**Cahul**	**Eur**	**89.0**	**0.69**	**31**
Sarygamysh	Asia	3777.7	0.82	32		Ihema	Afr.	93.2	0.56	32		**Titicaca**	**S.Am**	**7480.0**	**0.71**	**32**
Mweru	Afr.	5021.5	0.81	33		Victoria	Afr.	66841.5	0.56	33		**Chungarkkota**	**S.Am**	**52.6**	**0.71**	**33**
Cahora Bassa	Afr.	4347.4	0.78	34		Scutari/Skadar	Eur	381.5	0.55	34		**Dead Sea**	**Eur**	**642.7**	**0.72**	**34**
Itaipu	S.Am	1154.1	0.75	35		Shardara/Kara-Kul	Asia	746.1	0.54	35		**Lago de Yacyreta**	**S.Am**	**1109.4**	**0.73**	**35**
Kariba	Afr.	5258.6	0.75	36		Huron	N.Am	60565.2	0.53	36		**Aras Su Qovsaginin Su Anbari**	**Asia**	**52.1**	**0.73**	**36**
Lago de Yacyreta	S.Am	1109.4	0.75	37		Josini/Pongola-poort Dam	Afr.	128.6	0.52	37		**Itaipu**	**S.Am**	**1154.1**	**0.73**	**37**
Lake Congo River	Afr.	306.0	0.75	38		Champlain	N.Am	1098.9	0.51	38		**Salto Grande**	**S.Am**	**532.9**	**0.74**	**38**
Caspian Sea	Asia	377543.2	0.73	39		Ohrid	Eur	354.3	0.51	39		**Ohrid**	**Eur**	**354.3**	**0.74**	**39**
Salto Grande	S.Am	532.9	0.67	40		Macro Prespa	Eur	263.0	0.51	40		**Macro Prespa**	**Eur**	**263.0**	**0.75**	**40**
Scutari/Skadar	Eur	381.5	0.62	41		Dead Sea	Eur	642.7	0.51	41		**Caspian Sea**	**Asia**	**377543.2**	**0.77**	**41**
Neusiedler/Ferto	Eur	141.9	0.58	42		Maggiore	Eur	211.4	0.49	42		**Scutari/Skadar**	**Eur**	**381.5**	**0.78**	**42**
Szczecin Lagoon	Eur	822.4	0.53	43		Szczecin Lagoon	Eur	822.4	0.49	43		**Szczecin Lagoon**	**Eur**	**822.4**	**0.83**	**43**
Erie	N.Am	26560.8	0.51	44		Ontario	N.Am	19062.2	0.47	44		**Falcon**	**N.Am**	**120.6**	**0.85**	**44**
Macro Prespa)	Eur	263.0	0.51	45		Aras Su Qovsaginin Su Anbari	Asia	52.1	0.47	45		**Amistad**	**N.Am**	**131.3**	**0.86**	**45**
Falcon	N.Am	120.6	0.50	46		Darbandikhan	Asia	114.3	0.46	46		**Galilee**	**Eur**	**162.0**	**0.88**	**46**
Amistad	N.Am	131.3	0.49	47		Galilee	Eur	162.0	0.45	47		**Neusiedler/Ferto**	**Eur**	**141.9**	**0.88**	**47**
Ontario	N.Am	19062.2	0.48	48		Michigan	N.Am	58535.5	0.44	48		**Lake Maggiore**	**Eur**	**211.4**	**0.89**	**48**
Ohrid	Eur	354.3	0.47	49		Erie	N.Am	26560.8	0.43	49		**Ontario**	**N.Am**	**19062.2**	**0.92**	**49**
Michigan	N.Am	58535.5	0.44	50		Neusiedler/Ferto	Eur	141.9	0.39	50		**Huron**	**N.Am**	**60565.2**	**0.93**	**50**
Huron	N.Am	60565.2	0.42	51		Cahul	Eur	89.0	0.39	51		**Erie**	**N.Am**	**26560.8**	**0.93**	**51**
Maggiore	Eur	211.4	0.33	52		Mangla	Asia	85.4	0.38	52		**Champlain**	**N.Am**	**1098.9**	**0.94**	**52**
Champlain	N.Am	1098.9	0.29	53		Falcon	N.Am	120.6	0.38	53		**Michigan**	**N.Am**	**58535.5**	**0.94**	**53**

Transboundary Lake Threat Ranks by Multiple Ranking Criteria

(Cont., continent; Eur, Europe; N.Am, North America; Afr, Africa; S.Am, South America;
Adj-HWS, Adjusted Human Water Security threat; HWS, Incident Human Water Security threat; BD, Incident Biodiversity threat;
HDI, Human Development Index, RvBD, surrogate for 'Adjusted' Biodiversity threat;
Estimated risks: Red – highest; Orange – moderately high; Yellow – medium; Green – moderately low; Blue – low)

Cont.	Lake Name	Adj-HWS Threat	RvBD Threat	HDI	Adj-HWS Rank	HDI Rank	RvBD Rank	Sum Adj-HWS + RvBD	Relative Rank	Sum Adj-HWS + HDI	Relative Rank	Sum Adj-HWS + RvBD + HDI	Overall Rank
Afr	Abbe/Abhe	0.93	0.71	0.40	7	7	7	14	1	14	3	21	1
Afr	Turkana	0.90	0.70	0.41	13	10	9	22	2	23	10	32	2
Afr	Selingue	0.87	0.68	0.36	16	2	15	31	11	18	5	33	3
Afr	Malawi/Nyasa	0.91	0.68	0.42	9	12	14	23	3	21	9	35	4
Afr	Chiuta	0.85	0.74	0.41	23	9	3	26	5	32	15	35	4
Afr	Cohoha	0.96	0.59	0.38	3	4	28	31	2	7	1	35	4
Afr	Kivu	0.91	0.67	0.38	12	6	18	30	8	18	4	36	7
Afr	Rweru/Moero	0.96	0.58	0.36	4	3	30	34	16	7	2	37	8
Afr	Lake Congo River	0.75	0.78	0.34	35	1	1	36	18	36	19	37	8
Afr	Tanganyika	0.84	0.71	0.40	26	8	6	32	14	34	17	40	10
Afr	Edward	0.94	0.65	0.43	6	13	22	28	7	19	6	41	11
Afr	Chilwa	0.86	0.70	0.41	21	11	10	31	10	32	14	42	12
Afr	Mweru	0.81	0.72	0.38	33	5	4	37	21	38	20	42	12
Asia	Sistan	0.98	0.62	0.46	1	20	25	26	6	21	8	46	14
Afr	Natron/Magadi	0.93	0.67	0.51	8	23	17	25	4	31	13	48	15
Afr	Nasser/Aswan	0.86	0.68	0.43	20	16	16	36	19	36	18	52	16
Afr	Albert	0.91	0.63	0.46	10	19	24	34	15	29	12	53	17
Afr	Ihema	0.97	0.56	0.44	2	18	33	35	17	20	7	53	17
S.Am,	Azuei	0.96	0.57	0.46	5	21	31	36	20	26	11	57	19
Asia	Aral Sea	0.84	0.62	0.60	27	26	5	32	13	53	31	58	20
Asia	Sarygamysh	0.82	0.75	0.67	29	29	2	31	9	58	32	60	21
Afr	Cahora Bassa	0.78	0.69	0.43	34	15	13	47	25	49	25	62	22
Afr	Victoria	0.91	0.56	0.47	11	22	32	43	24	33	16	65	23
Afr	Chad	0.84	0.64	0.43	25	17	23	48	26	42	21	65	23
Afr	Kariba	0.75	0.66	0.43	36	14	19	55	30	50	28	69	25

S.Am	Titicaca	0.82	0.71	0.71	32	32	8	40	22	25	35	72	26
Afr	Aby	0.83	0.65	0.52	28	24	21	49	27	52	30	73	27
S.Am	Chungarkkota	0.82	0.69	0.71	31	33	12	43	23	64	34	76	28
Asia	Shardara/Kara-kul	0.86	0.54	0.65	22	28	35	57	31	50	27	85	29
Eur	Dead Sea	0.90	0.51	0.72	14	34	38	52	29	48	24	86	30
Afr	Josini/Pongola-poort Dam	0.85	0.52	0.61	24	27	37	61	34	51	29	88	31
S.Am	Salto Grande	0.67	0.70	0.74	40	38	11	51	28	78	39	89	32
Asia	Darbandikhan	0.87	0.46	0.68	17	30	46	63	35	47	23	93	33
S.Am	Lago de Yacyreta	0.75	0.66	0.73	38	36	20	58	32	74	38	94	34
Asia	Aras Su Qovsaginin Su Anbari	0.89	0.47	0.73	15	35	44	59	33	50	26	94	34
Asia	Mangla	0.87	0.38	0.54	18	25	53	71	39	43	22	96	36
S.Am	Itaipu	0.75	0.58	0.73	37	37	29	66	37	74	37	103	37
Asia	Caspian Sea	0.73	0.60	0.77	39	41	27	66	36	80	40	107	38
Eur	Galilee	0.87	0.45	0.88	19	46	47	66	38	65	36	112	39
Eur	Cahul	0.82	0.39	0.69	30	31	51	81	42	61	33	112	39
Eur	Scutari/Skadar	0.62	0.55	0.78	41	42	34	75	41	83	41	117	41
N.Am	Amistad	0.49	0.61	0.86	47	45	26	73	40	47	40	118	42
Eur	Macro Prespa (Large Prespa)	0.51	0.51	0.75	44	40	40	84	43	84	42	124	43
Eur	Ohrid	0.47	0.51	0.74	49	39	39	88	46	88	44	127	44
Eur	Szczecin Lagoon	0.53	0.49	0.83	43	43	43	86	44	86	43	129	45
N.Am	Huron	0.42	0.53	0.93	51	50	36	87	45	101	51	137	46
Eur	Neusiedler/Ferto	0.58	0.39	0.88	42	47	50	92	47	89	45	139	47
N.Am	Ontario	0.48	0.47	0.92	48	49	45	93	48	97	49	142	48
Eur	Lake Maggiore	0.33	0.50	0.89	52	48	42	94	50	100	50	142	48
N.Am	Falcon	0.50	0.38	0.85	46	44	52	98	53	90	46	142	48
N.Am	Erie	0.51	0.43	0.93	45	51	49	94	51	96	48	145	51
N.Am	Champlain	0.29	0.51	0.94	53	52	41	94	49	105	53	146	52
N.Am	Michigan	0.44	0.44	0.94	50	53	48	98	52	103	52	151	53

Earth Science and Remote Sensing Unit, NASA Johnson Space Center at http://www.eol.sc.nasa.gov

Transboundary River Basins of Central America & Caribbean

1. Artibonite
2. Belize
3. Candelaria
4. Chamelecon
5. Changuinola
6. Chiriqui
7. Choluteca
8. Coatan Achute
9. Coco/ Segovia
10. Colorado
11. Conventillos
12. Corredores/ Colorado
13. El Naranjo
14. Goascoran
15. Grijalva
16. Hondo
17. Jurado
18. Lempa
19. Massacre
20. Moho
21. Motaqua
22. Negro
23. Paz
24. Pedernales
25. Rio Grande (North America)
26. San Juan
27. Sarstun
28. Sixaola
29. Suchiate
30. Temash
31. Tijuana
32. Yaqui

UNEP-DHI PARTNERSHIP
Centre on Water and Environment
UNEP DHI
IUCN
SIWI
CUNY The City University of New York
OSU Oregon State University
GLOBAL IGBP CHANGE International Geosphere-Biosphere Programme
Center for International Earth Science Information Network
Earth Institute | Columbia University
CESR Center for Environmental Systems Research
Delta Alliance

Artibonite Basin

Geography

Total drainage area (km^2)	8,860
No. of countries in basin	2
BCUs in basin	Dominican Republic (DOM), Haiti (HTI)
Population in basin (people)	1,455,738
Country at mouth	Haiti
Average rainfall (mm/year)	1,345

Governance

No. of treaties and agreements[1]	2
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	1
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
ATBN_DOM		253.99				
ATBN_HTI		324.71				
Total in Basin	2.72	307.02			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
ATBN_DOM	267.83	168.04	2.36	0.00	3	94.68	1,873.53	
ATBN_HTI	790.50	602.81	13.17	23.63	5	146.07	602.15	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	1,058.32	770.85	15.53	23.63	7.55	240.76	727.00	38.91

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
ATBN_DOM	3	0.29	143	54.82	1.38	0.00	100.00	0	5,826.13	0	0.00
ATBN_HTI	6	0.71	1,313	209.98	1.34	0.00	100.00	0	819.90	0	0.00
Total in Basin	9	1.00	1,456	164.31	1.39	0.00	100.00	0	1,311.51	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
ATBN_DOM	2		2		5	3			3	3	2		4	3	2
ATBN_HTI	2	2	2		5	4	2		3	3	4	5	3	4	3
River Basin	2	2	2	4	5	4	2		3	3	4	5	4	5	3

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low — Low — Medium — High — Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
ATBN_DOM	3	5							2
ATBN_HTI	3	4	3	4			2	3	4
River Basin	3	4	3	4	5	5	2	3	4

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

Disclaimer

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GEF TWAP is the first global-scale assessment of all transboundary water systems. The TWAP consists of five independent indicator-based water system assessments and the linkages between them, including their socioeconomic and governance-related features. The United Nations Environment Programme (UNEP) is the implementing agency of TWAP. Project Coordination Unit (PCU) in Nairobi, Kenya coordinates the work of UNESCO-IHP, ILEC, UNEP-DHI and the IOC of UNESCO on Transboundary Aquifers, Lake Basins, River Basins, Large Marine Ecosystems and Open Ocean respectively. Each executing partner engages a broad network of data and information rich partners with responsibilities either of a thematic or geographic nature. More on TWAP full size project at http://www.geftwap.org .

The TWAP River Basins component (TWAP RB) carried out a global comparison of 286 transboundary river basins, in order to enable the prioritisation of funds for basins at risk from a variety of issues, covering water quantity, water quality, ecosystems, governance and socio-economics. It also considered risks to deltas from threats of a transboundary nature, and considered the relative influence of lakes on these river basins. TWAP RB is an indicator–based assessment, allowing for an analysis of basins, based on risks to both societies and ecosystems. It also includes provisional outlook projections to 2030 and 2050 for a limited number of indicators.
Values given in the present fact-sheet represent an approximate guide only and should not replace recent local assessments.

Country Boundaries Under TWAP
TWAP RB assessment uses country delineations provided by FAO GAUL (Global Administrative Unit Layers) (FAO 2014). GAUL uses the International Boundary dataset of the UNCS (UN Cartographic Section) and inland boundaries are same for both datasets. Some differences occur in coastlines, where FAO GAUL dataset offers more detail.

Disputed areas
The GAUL project and original dataset maintains disputed areas in such a way to preserve national integrity for all disputing countries. The GAUL Set reports the international, first level and second level administrative boundaries delimiting, or falling within, the disputed areas in a way to enable the re-construction of the administrative units as they are specified by the individual disputing countries. Disputed areas are therefore shown as individual entities, not dependent from countries, with corresponding coding. Same approach has been taken by TWAP RB, reporting on disputed territories, as well as presentation of Basin Country Units.

Basin Delineation
TWAP RB assessment includes 286 transboundary river basins. Information on this layer and delineation methodology can be retrieved by downloading metadata sheet for the Basins layer from TWAP Rivers Data Portal at http://twap-rivers.org/indicators/ or by direct download from http://twap-rivers.org/assets/Basin%20and%20BCU%20Creation%20Documentation.pdf

For more information on data sources, indicator calculation methodologies, limitations and more consult indicator metadata sheets available on TWAP RB Data portal on http://twap-rivers.org . To view sources of data included in this Factsheet download the Factsheet Reference file at http://twap-rivers.org/assets/Factsheet_template_with_references.pdf.

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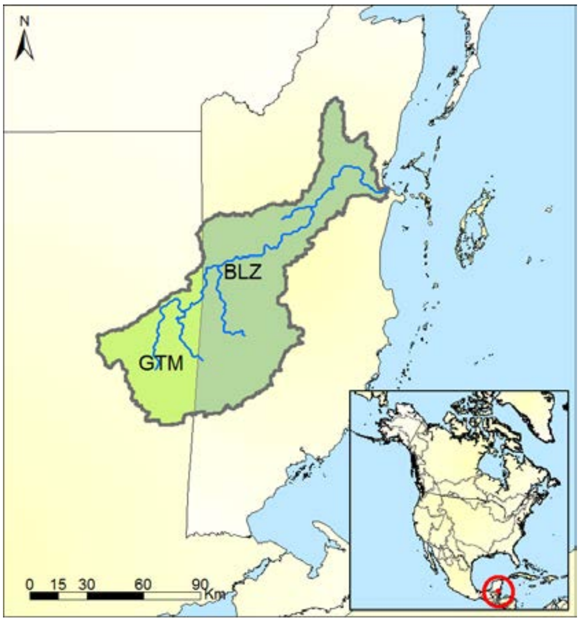
Belize Basin



Geography

Total drainage area (km²)	8,493
No. of countries in basin	2
BCUs in basin	Belize (BLZ), Guatemala (GTM)
Population in basin (people)	109,916
Country at mouth	Belize
Average rainfall (mm/year)	2,086

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
BLZE_BLZ		618.06				
BLZE_GTM		670.31				
Total in Basin	5.34	628.53			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
BLZE_BLZ	31.46	1.57	0.32	3.98	21	4.15	424.90	
BLZE_GTM	1.10	0.25	0.17	0.00	0	0.68	30.65	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	32.56	1.82	0.49	3.98	21.44	4.83	296.20	0.61

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
BLZE_BLZ	6	0.71	74	12.27	2.07	0.00	100.00	0	4,834.29	0	0.00
BLZE_GTM	2	0.29	36	14.60	2.47			0	3,477.89	0	0.00
Total in Basin	8	1.00	110	12.94	2.43	0.00	67.36	0	4,391.51	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
BLZE_BLZ	1	1	2		5		1	3	2	5	3	4	3	2	3
BLZE_GTM	1	1	2		5		1	3	2	5	3	4	1	3	3
River Basin	1	1	2	2	5		1	4	2	5	3	4	2	2	3

Indicators

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
BLZE_BLZ	3	3	1	1			2	4	3
BLZE_GTM	3	4	1	1			3	5	3
River Basin	3	4	1	1	2	2	3	5	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

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Candelaria Basin

Geography

Total drainage area (km^2)	14,609
No. of countries in basin	2
BCUs in basin	Guatemala (GTM), Mexico (MEX)
Population in basin (people)	168,179
Country at mouth	Mexico
Average rainfall (mm/year)	1,560

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	2

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CDLR_GTM		302.93				
CDLR_MEX		348.68				
Total in Basin	4.84	331.49			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CDLR_GTM	1.98	0.32	0.42	0.00	0	1.24	203.65	
CDLR_MEX	21.84	0.58	1.64	0.52	0	19.10	137.83	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	23.82	0.90	2.06	0.52	0.00	20.34	141.63	0.49

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
CDLR_GTM	2	0.16	10	4.17	2.47			0	3,477.89	0	0.00
CDLR_MEX	12	0.84	158	12.91	1.26	0.00	100.00	0	10,307.28	0	0.00
Total in Basin	15	1.00	168	11.51	1.30	0.00	94.22	0	9,912.40	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CDLR_GTM	1	1	2		5	3	1	3	1	4	2	4	1	3	2
CDLR_MEX	1	1	2		4	4	2	4	1	4	2	2	1	2	3
River Basin	1	1	2	2	4	4	1	4	1	4	2	2	1	3	3

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
CDLR_GTM	4	4	1	1			2	4	2
CDLR_MEX	3	4	1	1			1	2	2
River Basin	3	4	1	1	2	2	2	2	2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Chamelecon Basin

Geography

Total drainage area (km^2)	4,432
No. of countries in basin	2
BCUs in basin	Guatemala (GTM), Honduras (HND)
Population in basin (people)	1,381,999
Country at mouth	Honduras
Average rainfall (mm/year)	1,923

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	1
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CHAM_GTM						
CHAM_HND		645.26				
Total in Basin	2.86	645.26			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CHAM_GTM								
CHAM_HND	265.50	38.75	3.86	162.64	31	29.28	192.16	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	265.50	38.75	3.86	162.64	30.98	29.28	192.12	9.28

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
CHAM_GTM	0	0.00	0	72.98	2.47			0	3,477.89	0	0.00
CHAM_HND	4	1.00	1,382	312.06	1.99	0.00	100.00	2	2,290.78	0	0.00
Total in Basin	4	1.00	1,382	311.85	2.02	0.00	99.98	2	2,291.03	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CHAM_GTM					5				3	5	3	4	1	4	
CHAM_HND	4	1	2		5	1	4	2	3	5	3	3	3	3	2
River Basin	5	1	2	3	5	1	4	2	3	5	3	3	3	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
CHAM_GTM									3
CHAM_HND	5	5	2	4			2	4	3
River Basin	5	5	2	4	4	4	2	4	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Changuinola Basin

Geography

Total drainage area (km^2)	3,216
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Panama (PAN)
Population in basin (people)	68,125
Country at mouth	Panama
Average rainfall (mm/year)	2,838

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CGNL_CRI						
CGNL_PAN		1,229.89				
Total in Basin	3.96	1,229.89			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CGNL_CRI								
CGNL_PAN	44.92	0.54	0.96	0.97	1	41.01	699.79	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	44.92	0.54	0.96	0.97	1.44	41.01	659.31	1.14

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km²)
CGNL_CRI	0	0.07	4	16.61	1.56			0	10,184.61	0	0.00
CGNL_PAN	3	0.93	64	21.55	1.65	0.00	100.00	0	11,036.81	0	0.00
Total in Basin	3	1.00	68	21.18	1.60	0.00	94.22	0	10,987.51	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CGNL_CRI					5				4	5	3	3	1	2	1
CGNL_PAN	1	1	1		4	1	2		4	5	3	3	1	3	3
River Basin	1	1	1	2	5	1	2	2	3	5	3	3	1	3	3

Indicators

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Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
CGNL_CRI									3
CGNL_PAN	2	2	1	1			2	3	3
River Basin	2	2	1	1	2	2	2	3	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

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Chiriqui Basin

Geography

Total drainage area (km²)	1,403
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Panama (PAN)
Population in basin (people)	90,273
Country at mouth	Panama
Average rainfall (mm/year)	3,617

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CHRQ_CRI						
CHRQ_PAN		2,458.58				
Total in Basin	3.45	2,458.58			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CHRQ_CRI								
CHRQ_PAN	47.66	1.33	2.81	0.00	3	40.93	540.10	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	47.66	1.33	2.81	0.00	2.60	40.93	527.94	1.38

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
CHRQ_CRI	0	0.03	2	55.93	1.56			0	10,184.61	0	0.00
CHRQ_PAN	1	0.97	88	64.54	1.65	0.00	100.00	0	11,036.81	0	0.00
Total in Basin	1	1.00	90	64.32	1.61	0.00	97.75	0	11,017.62	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CHRQ_CRI					5	4			3	5	3	3	1	2	1
CHRQ_PAN	1	1	2		4	4			3	5	5	3	2	3	2
River Basin	1	1	2	2	5	5			3	5	5	3	2	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low Low Medium High Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
CHRQ_CRI									3
CHRQ_PAN	2	2	1	1			2	2	5
River Basin	2	2	1	1	2	2	2	2	5

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Choluteca Basin

Geography

Total drainage area (km^2)	8,049
No. of countries in basin	2
BCUs in basin	Honduras (HND), Nicaragua (NIC)
Population in basin (people)	1,627,485
Country at mouth	Honduras
Average rainfall (mm/year)	1,297

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CHLT_HND		572.12				
CHLT_NIC		494.32				
Total in Basin	4.48	556.55			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CHLT_HND	287.59	66.36	5.40	151.64	31	32.83	178.21	
CHLT_NIC	6.06	1.56	0.93	0.00	1	2.99	442.49	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	293.65	67.92	6.33	151.64	31.94	35.82	180.43	6.55

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
CHLT_HND	8	0.97	1,614	207.71	1.99	0.00	100.00	1	2,290.78	0	0.00
CHLT_NIC	0	0.03	14	48.92	1.30			0	1,851.11	0	0.00
Total in Basin	8	1.00	1,627	202.19	2.01	0.00	99.16	1	2,287.08	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CHLT_HND	1	1	2		5	2	3	1	2	5	3	3	4	3	2
CHLT_NIC	1	1	2		5		2	1	1	5	3	5	1	3	1
River Basin	1	1	2	4	5	2	3	1	2	5	3	3	4	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low Low Medium High Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
CHLT_HND	2	3	3	4			2	4	3
CHLT_NIC	2	4	1	1			2	3	3
River Basin	2	4	2	4	4	4	2	4	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

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Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Coatan Achute Basin

Geography

Total drainage area (km^2)	679
No. of countries in basin	2
BCUs in basin	Guatemala (GTM), Mexico (MEX)
Population in basin (people)	126,533
Country at mouth	Mexico
Average rainfall (mm/year)	

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CTAT_GTM						
CTAT_MEX						
Total in Basin					0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CTAT_GTM								
CTAT_MEX								

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin								

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
CTAT_GTM	0	0.39	44	164.97	2.47			0	3,477.89	0	0.00
CTAT_MEX	0	0.61	83	199.81	1.26	0.00	100.00	1	10,307.28	0	0.00
Total in Basin	1	1.00	127	186.28	1.67	0.00	65.59	1	7,957.16	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CTAT_GTM					5				2	5	2	4	1	3	1
CTAT_MEX					4	4			2	5	2	2	1	2	1
River Basin				3	4				2	5	2	3	1	3	1

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
CTAT_GTM									2
CTAT_MEX							2	3	2
River Basin					4	4	2	3	2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin					

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Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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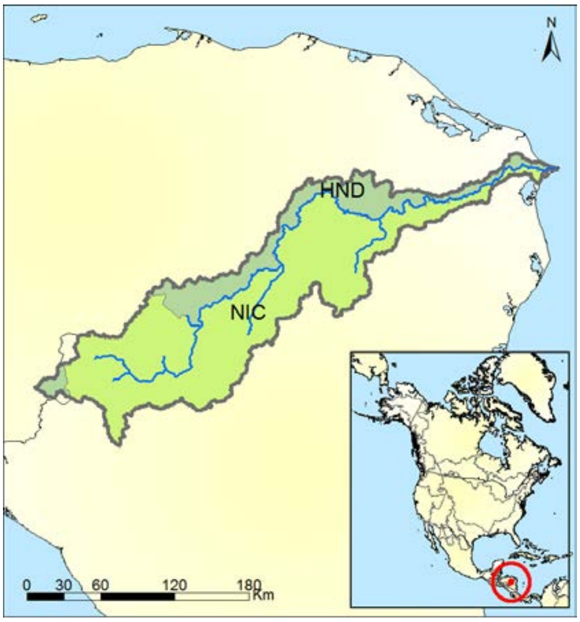
Coco/Segovia Basin



Geography

Total drainage area (km²)	24,509
No. of countries in basin	2
BCUs in basin	Honduras (HND), Nicaragua (NIC)
Population in basin (people)	895,266
Country at mouth	Honduras, Nicaragua
Average rainfall (mm/year)	2,309

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	3
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
COCO_HND		1,513.70				
COCO_NIC		957.39				
Total in Basin	25.73	1,049.80			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
COCO_HND	0.92	0.03	0.18	0.00	0	0.71	11.86	
COCO_NIC	52.36	5.79	8.86	0.00	5	32.89	64.00	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	53.27	5.82	9.04	0.00	4.82	33.59	59.50	0.21

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
COCO_HND	6	0.23	77	13.77	1.99	0.00	100.00	0	2,290.78	0	0.00
COCO_NIC	19	0.77	818	43.28	1.30	0.00	100.00	0	1,851.11	0	0.00
Total in Basin	25	1.00	895	36.53	1.52	0.00	100.00	0	1,889.03	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
COCO_HND	1	1	1		5	2	1	2	1	5	3	3	1	3	2
COCO_NIC	1	1	2		5	2	2	2	1	5	3	5	1	3	2
River Basin	1	1	1	2	5	2	2	2	1	5	3	5	1	4	2

Indicators

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
COCO_HND	2	3	1	1			2	3	3
COCO_NIC	2	3	1	1			2	2	3
River Basin	2	3	1	1	2	2	2	2	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

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Colorado Basin

Geography

Total drainage area (km^2)	626,050
No. of countries in basin	2
BCUs in basin	Mexico (MEX), United States (USA)
Population in basin (people)	8,794,418
Country at mouth	Mexico
Average rainfall (mm/year)	339

Governance

No. of treaties and agreements[1]	21
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	11
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CLDO_MEX		10.06				
CLDO_USA		41.01			2,042.20	92.61
Total in Basin	25.19	40.23			2,042.20	92.61

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CLDO_MEX	3,160.74	3,034.55	3.31	18.72	21	83.38	11,483.49	
CLDO_USA	18,334.76	15,567.07	47.14	520.02	611	1,589.12	2,152.18	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	21,495.50	18,601.62	50.45	538.74	632.20	1,672.49	2,444.22	85.34

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
CLDO_MEX	6	0.01	275	44.90	1.26	0.00	100.00	1	10,307.28	0	0.00
CLDO_USA	620	0.99	8,519	13.74	0.89	4.16	95.84	15	53,142.89	82	132.28
Total in Basin	626	1.00	8,794	14.05	0.73	4.03	95.97	16	51,802.25	82	130.98

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CLDO_MEX	5	5	5		4	4	5	5	1	2	1	2	2	2	5
CLDO_USA	4	4	5		2	2	5	4	2	2	1	2	1	2	5
River Basin	5	4	5	1	2	2	5	4	1	2	1	2	1	2	5

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
CLDO_MEX	5	5	5	5			1	2	2
CLDO_USA	5	5	4	4			1	1	1
River Basin	5	5	4	5	1	1	1	2	1

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	5	4	1	2	5

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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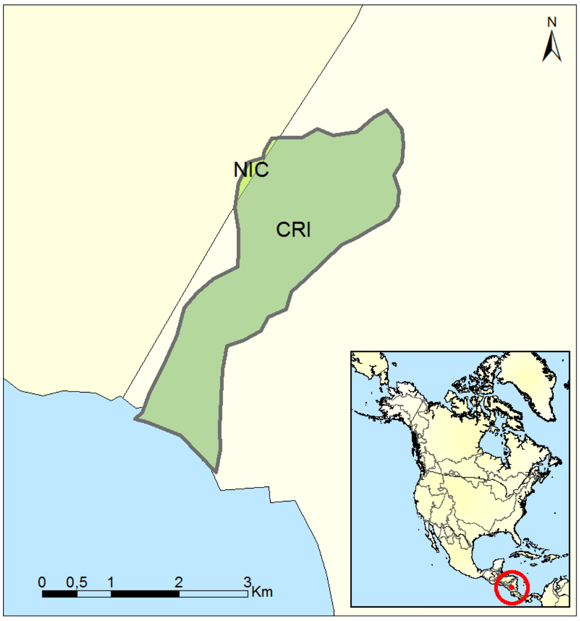
Conventillos Basin



Geography

Total drainage area (km²)	7
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Nicaragua (NIC)
Population in basin (people)	182
Country at mouth	Costa Rica
Average rainfall (mm/year)	

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CONV_CRI						
CONV_NIC						
Total in Basin					0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CONV_CRI								
CONV_NIC								

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Total in Basin								

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
CONV_CRI	0	0.98	0	27.18	1.56			0	10,184.61	0	0.00
CONV_NIC	0	0.02	0	0.00	1.30			0	1,851.11	0	0.00
Total in Basin	0	1.00	0	26.76	1.38	0.00	0.00	0	10,184.61	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CONV_CRI					5					5	3	3	1	2	1
CONV_NIC					5					5	3	5	1	3	
River Basin					5					5	3	3	1	2	1

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
CONV_CRI									3
CONV_NIC									3
River Basin									3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin					

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Corredores/Colorado Basin

Geography

Total drainage area (km^2)	1,139
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Panama (PAN)
Population in basin (people)	47,994
Country at mouth	Costa Rica
Average rainfall (mm/year)	3,388

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
CORR_CRI		2,425.52				
CORR_PAN		624.01				
Total in Basin	1.74	1,524.19			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
CORR_CRI	21.04	13.07	0.07	0.04	0	7.86	447.95	
CORR_PAN	39.55	4.01	1.46	6.61	2	25.66	38,816.36	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	60.59	17.08	1.53	6.65	1.82	33.52	1,262.53	3.49

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
CORR_CRI	1	0.98	47	41.89	1.56			0	10,184.61	0	0.00
CORR_PAN	0	0.02	1	56.29	1.65			0	11,036.81	0	0.00
Total in Basin	1	1.00	48	42.12	1.39	0.00	0.00	0	10,202.70	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CORR_CRI	1		2		5	5			2	5	3	3	1	2	1
CORR_PAN	1		2		4	5			2	5	3	3	3	3	1
River Basin	1		2	2	5				2	5	3	3	1	3	1

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
CORR_CRI	3	3							3
CORR_PAN	2	2							3
River Basin	3	3			2	3			3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

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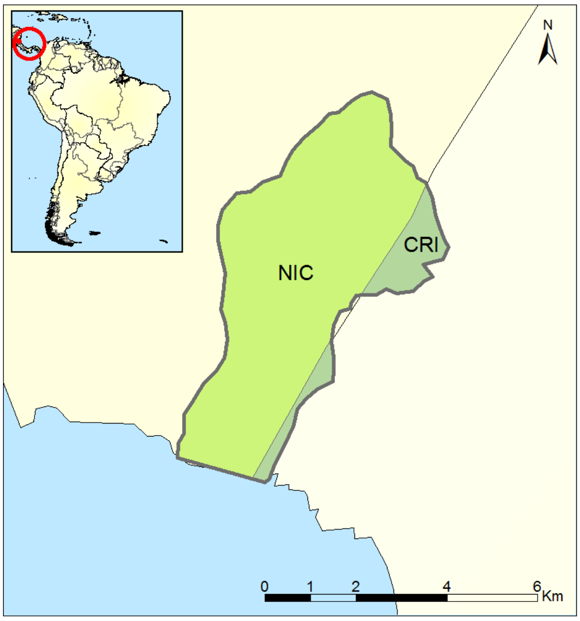
El Naranjo Basin



Geography

Total drainage area (km^2)	24
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Nicaragua (NIC)
Population in basin (people)	569
Country at mouth	Nicaragua
Average rainfall (mm/year)	

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
ELNA_CRI						
ELNA_NIC						
Total in Basin					0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
ELNA_CRI								
ELNA_NIC								

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[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin								

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
ELNA_CRI	0	0.12	0	10.43	1.56			0	10,184.61	0	0.00
ELNA_NIC	0	0.88	1	25.47	1.30			0	1,851.11	0	0.00
Total in Basin	0	1.00	1	23.71	1.47	0.00	0.00	0	2,279.73	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ELNA_CRI					5					5	3	3	1	2	1
ELNA_NIC					5					5	3	5	1	3	1
River Basin					5					5	3	5	1	3	1

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low Low Medium High Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
ELNA_CRI									3
ELNA_NIC									3
River Basin									3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin					

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Goascoran Basin

Geography

Total drainage area (km^2)	2,746
No. of countries in basin	2
BCUs in basin	El Salvador (SLV), Honduras (HND)
Population in basin (people)	247,324
Country at mouth	El Salvador
Average rainfall (mm/year)	1,445

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
GOSR_HND						
GOSR_SLV		434.48				
Total in Basin	1.19	434.48			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
GOSR_HND								
GOSR_SLV	15.76	1.23	1.68	0.34	3	9.19	87.01	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	15.76	1.23	1.68	0.34	3.33	9.19	63.73	1.32

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
GOSR_HND	1	0.51	66	46.98	1.99			0	2,290.78	0	0.00
GOSR_SLV	1	0.49	181	135.41	0.47	0.00	100.00	0	3,826.08	0	0.00
Total in Basin	3	1.00	247	90.06	1.04	0.00	73.25	0	3,415.37	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
GOSR_HND					5	3			2	5	3	3	1	3	2
GOSR_SLV	1	1	2		5	5	2	3	1	5	3	5	1	3	2
River Basin	1	1	2	4	5	5	3	1	2	5	3	5	1	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
GOSR_HND									3
GOSR_SLV	2	4	1	4			3	5	3
River Basin	2	4	1	3	4	4	3	5	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Grijalva Basin

Geography

Total drainage area (km²)	125,675
No. of countries in basin	3
BCUs in basin	Belize (BLZ), Guatemala (GTM), Mexico (MEX)
Population in basin (people)	8,302,439
Country at mouth	Mexico
Average rainfall (mm/year)	2,201

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	2

Geographical Overlap with Other Transboundary Systems
(No. of overlapping water systems)

Groundwater	
Lakes	5
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
GJLV_BLZ						
GJLV_GTM		1,176.36				
GJLV_MEX		933.51			1,143.80	13.56
Total in Basin	127.11	1,011.43			1,143.80	13.56

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
GJLV_BLZ								

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[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

GJLV_GTM	116.31	14.27	6.31	0.00	26	70.14	34.16	
GJLV_MEX	1,074.90	135.45	29.46	0.25	190	720.15	219.51	
Total in Basin	1,191.21	149.72	35.77	0.25	215.18	790.30	143.48	0.94

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km²)
GJLV_ BLZ	0	0.00	0	8.64	2.07			0	4,834.29	0	0.00
GJLV_ GTM	47	0.37	3,405	72.54	2.47	0.00	100.00	0	3,477.89	1	21.30
GJLV_ MEX	79	0.63	4,897	62.22	1.26	0.00	100.00	3	10,307.28	5	63.53
Total in Basin	126	1.00	8,302	66.06	1.76	0.00	100.00	3	7,505.98	6	47.74

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
GJLV_BLZ					5				2	5	3	4	1	2	1
GJLV_GTM	1	1	2		5	1	2	4	5	4	4	4	2	3	2
GJLV_MEX	2	1	2		4	3	3	4	5	4	4	2	1	2	3
River Basin	2	1	2	2	4	3	3	4	4	4	4	3	1	3	3

Indicators

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
GJLV_BLZ									3
GJLV_GTM	2	3	1	1			3	5	4
GJLV_MEX	3	3	1	1			1	2	4
River Basin	3	4	1	1	3	3	2	4	4

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TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1	4	1	2	5

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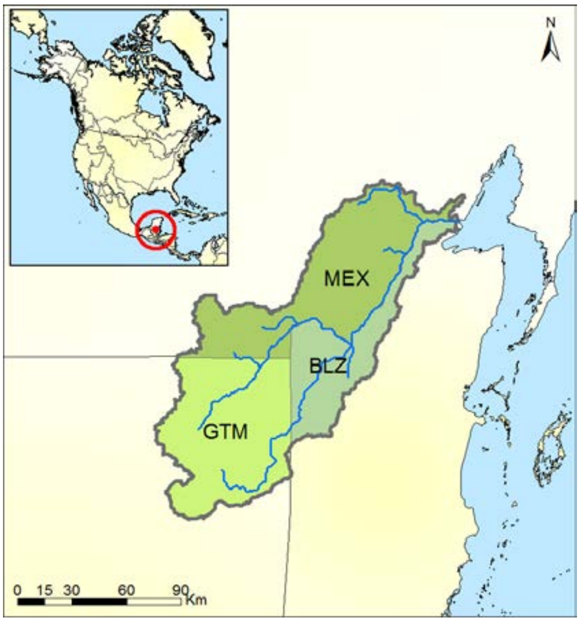
Hondo Basin



Geography

Total drainage area (km^2)	12,699
No. of countries in basin	3
BCUs in basin	Belize (BLZ), Guatemala (GTM), Mexico (MEX)
Population in basin (people)	162,784
Country at mouth	Belize, Mexico
Average rainfall (mm/year)	1,475

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems
(No. of overlapping water systems)

Groundwater	
Lakes	1
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
HOND_BLZ		276.43				
HOND_GTM		346.60				
HOND_MEX		187.12				
Total in Basin	3.10	244.08			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
HOND_BLZ	5.17	1.15	0.17	0.00	3	0.91	179.61	

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HOND_GTM	2.40	0.24	0.53	0.00	0	1.62	45.29	
HOND_MEX	94.73	61.82	1.30	3.50	6	22.46	1,168.91	
Total in Basin	102.29	63.21	2.00	3.50	8.60	24.99	628.40	3.30

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
HOND_BLZ	3	0.21	29	10.64	2.07			0	4,834.29	0	0.00
HOND_GTM	5	0.39	53	10.78	2.47			0	3,477.89	0	0.00
HOND_MEX	5	0.40	81	15.95	1.26			0	10,307.28	0	0.00
Total in Basin	13	1.00	163	12.82	1.85	0.00	0.00	0	7,117.48	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
HOND_BLZ	1	1	2		5		1	2	1	5	3	4	2	2	3
HOND_GTM	1	1	1		5		1	3	1	4	2	4	1	3	2
HOND_MEX	1	1	2		4	1	2	2	1	4	2	2	1	2	2
River Basin	1	1	2	2	4	1	1	3	1	4	2	3	1	3	2

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Very low Low Medium High Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	**1.Environmental water stress**		**2.Human water stress**		**4.Nutrient pollution**		**16.Change in population density**		**11.Hydropolitical tension**
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
HOND_BLZ	5	5	1	1					3
HOND_GTM	4	4	1	1			3	5	2
HOND_MEX	4	5	1	1			1	2	2
River Basin	4	5	1	1	3	3	2	3	2

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TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

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UNEP-DHI PARTNERSHIP
Centre on Water and Environment

Jurado Basin

Geography

Total drainage area (km²)	918
No. of countries in basin	2
BCUs in basin	Colombia (COL), Panama (PAN)
Population in basin (people)	4,570
Country at mouth	Colombia, Panama
Average rainfall (mm/year)	3,818

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
JURD_COL		2,573.37				
JURD_PAN		2,408.00				
Total in Basin	2.29	2,490.73			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
JURD_COL	1.85	0.00	0.70	0.00	0	1.16	534.85	
JURD_PAN	3.00	0.00	0.36	0.10	0	2.54	2,707.25	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	4.85	0.00	1.06	0.10	0.00	3.69	1,061.16	0.21

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
JURD_COL	1	0.70	3	5.39	1.46			0	7,825.68	0	0.00
JURD_PAN	0	0.30	1	4.03	1.65			0	11,036.81	0	0.00
Total in Basin	1	1.00	5	4.98	1.36	0.00	0.00	0	8,603.64	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
JURD_COL	1	1	1		5		1	2	2	5	3		1	3	1
JURD_PAN	1		1		4				2	5	3	3	1	3	1
River Basin	1	1	1	2	5		1	2	1	5	3		1	3	1

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
JURD_COL	2	2	1	1			1	2	3
JURD_PAN	2	2							3
River Basin	2	2	1	1	2	2	1	2	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Lempa Basin

Geography

Total drainage area (km^2)	18,216
No. of countries in basin	3
BCUs in basin	El Salvador (SLV), Guatemala (GTM), Honduras (HND)
Population in basin (people)	4,609,138
Country at mouth	El Salvador
Average rainfall (mm/year)	1,407

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	2
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
LMPA_GTM		577.86				
LMPA_HND		541.56				
LMPA_SLV		621.78			229.80	3.12
Total in Basin	10.75	590.21			229.80	3.12

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
LMPA_GTM	33.57	4.06	1.51	9.82	8	10.36	93.67	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

LMPA_HND	27.34	5.42	2.10	0.00	7	12.80	69.69	
LMPA_SLV	189.12	38.05	6.50	79.23	8	57.78	49.01	
Total in Basin	250.03	47.52	10.12	89.05	22.41	80.93	54.25	2.33

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
LMPA_GTM	3	0.14	358	137.64	2.47	0.00	100.00	0	3,477.89	0	0.00
LMPA_HND	5	0.30	392	71.75	1.99	0.00	100.00	0	2,290.78	0	0.00
LMPA_SLV	10	0.56	3,858	380.34	0.47	0.00	100.00	7	3,826.08	3	295.72
Total in Basin	18	1.00	4,609	253.03	0.94	0.00	100.00	7	3,668.34	3	164.69

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
LMPA_GTM	1	1	2		5		4	3	4	5	1	4	1	3	1
LMPA_HND	1	1	2		5	1	4	1	3	5	2	3	1	3	2
LMPA_SLV	2	1	2		5	1	4	3	3	5	3	5	5	3	2
River Basin	2	1	2	4	5	1	4	2	3	5	3	5	4	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
LMPA_GTM	2	3	2	4			3	5	1
LMPA_HND	2	4	1	1			3	5	2
LMPA_SLV	2	3	4	5			3	5	3
River Basin	2	4	3	4	4	5	3	5	3

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

TWAP RB Assessment results: Water System Linkages

Thematic group	**Lake Influence Indicator**	**Delta Vulnerability Index**			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

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Massacre Basin

Geography

Total drainage area (km²)	777
No. of countries in basin	2
BCUs in basin	Dominican Republic (DOM), Haiti (HTI)
Population in basin (people)	151,871
Country at mouth	Dominican Republic, Haiti
Average rainfall (mm/year)	1,027

Governance

No. of treaties and agreements[1]	2
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
MASS_DOM						
MASS_HTI		29.51				
Total in Basin	0.02	29.51			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
MASS_DOM								
MASS_HTI	238.82	200.06	1.08	3.34	1	33.23	1,877.59	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	238.82	200.06	1.08	3.34	1.11	33.23	1,572.48	1,041.22

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
MASS_DOM	0	0.46	25	68.69	1.38	0.00	100.00	0	5,826.13	0	0.00
MASS_HTI	0	0.54	127	304.35	1.34			0	819.90	0	0.00
Total in Basin	1	1.00	152	195.40	1.37	0.00	16.25	0	1,633.43	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
MASS_DOM					5	3			3	3	2		1	3	3
MASS_HTI	2		5		5	3			3	4	2	5	2	5	4
River Basin	2		5	4	5				3	4	2		1	4	3

Indicators

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
MASS_DOM									2
MASS_HTI	4	5							2
River Basin	4	5			5	5			2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	1				

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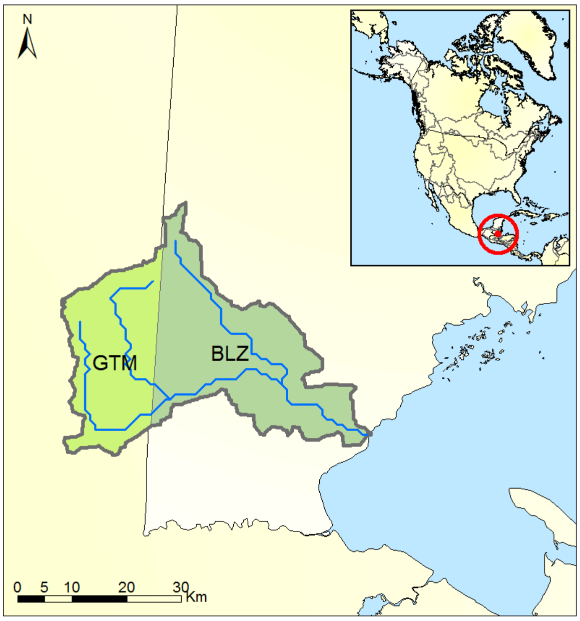
Moho Basin



Geography

Total drainage area (km^2)	1,189
No. of countries in basin	2
BCUs in basin	Belize (BLZ), Guatemala (GTM)
Population in basin (people)	16,646
Country at mouth	Belize
Average rainfall (mm/year)	3,167

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
MOHO_BLZ						
MOHO_GTM		1,870.10				
Total in Basin	2.22	1,870.10			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
MOHO_BLZ								
MOHO_GTM	1.23	0.11	0.19	0.00	0	0.93	99.62	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	1.23	0.11	0.19	0.00	0.00	0.93	73.92	0.06

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
MOHO_BLZ	1	0.61	4	5.92	2.07			0	4,834.29	0	0.00
MOHO_GTM	0	0.39	12	26.62	2.47			0	3,477.89	0	0.00
Total in Basin	1	1.00	17	14.00	2.49	0.00	0.00	0	3,827.82	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MOHO_BLZ					5				2	5	3	4	1	2	2
MOHO_GTM	1	1	1		5		1	4	2	5	3	4	1	3	1
River Basin	1	1	1	2	5		1	4	2	5	3	4	1	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
MOHO_BLZ									3
MOHO_GTM	3	3	1	1					3
River Basin	3	4	1	1	2	2			3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Motaqua Basin

Geography

Total drainage area (km^2)	16,271
No. of countries in basin	2
BCUs in basin	Guatemala (GTM), Honduras (HND)
Population in basin (people)	3,846,114
Country at mouth	Guatemala, Honduras
Average rainfall (mm/year)	1,771

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	2
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
MOTQ_GTM		930.11				
MOTQ_HND		583.73				
Total in Basin	13.60	835.74			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
MOTQ_GTM	354.36	43.07	10.65	55.84	126	118.70	96.41	
MOTQ_HND	79.48	25.02	3.31	23.60	12	15.29	466.53	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	433.84	68.08	13.96	79.44	138.37	133.99	112.80	3.19

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
MOTQ_GTM	14	0.87	3,676	258.32	2.47	0.00	100.00	1	3,477.89	0	0.00
MOTQ_HND	2	0.13	170	83.47	1.99	0.00	100.00	0	2,290.78	0	0.00
Total in Basin	16	1.00	3,846	236.38	2.50	0.00	100.00	1	3,425.31	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
MOTQ_GTM	1	1	2		5	1	3	3	4	5	3	4	4	3	2
MOTQ_HND	1	1	2		5	1	3	2	4	5	3	3	1	3	2
River Basin	1	1	2	4	5	1	3	3	4	5	3	4	4	3	2

Indicators

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Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
MOTQ_GTM	2	3	3	4			3	5	3
MOTQ_HND	2	3	1	1			3	5	3
River Basin	2	3	2	4	4	5	3	5	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	3				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Negro Basin

Geography

Total drainage area (km^2)	6,159
No. of countries in basin	2
BCUs in basin	Honduras (HND), Nicaragua (NIC)
Population in basin (people)	474,077
Country at mouth	Nicaragua
Average rainfall (mm/year)	1,694

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
NEGR_HND						
NEGR_NIC		905.21				
Total in Basin	5.57	905.21			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
NEGR_HND								
NEGR_NIC	116.28	68.88	3.38	21.14	4	18.50	306.57	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	116.28	68.88	3.38	21.14	4.37	18.50	245.28	2.09

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
NEGR_HND	1	0.16	95	95.48	1.99	0.00	100.00	0	2,290.78	0	0.00
NEGR_NIC	5	0.84	379	73.42	1.30	0.00	100.00	0	1,851.11	0	0.00
Total in Basin	6	1.00	474	76.98	1.58	0.00	100.00	0	1,939.02	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NEGR_HND					5	4			1	5	3	3	1	3	2
NEGR_NIC	1	1	2		5	2	3	1	1	5	3	5	2	3	2
River Basin	1	1	2	3	5	2	3	2	1	5	3	5	2	4	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
NEGR_HND									3
NEGR_NIC	2	3	1	1			2	3	3
River Basin	2	3	1	1	4	4	2	3	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Paz Basin

Geography

Total drainage area (km^2)	2,177
No. of countries in basin	2
BCUs in basin	El Salvador (SLV), Guatemala (GTM)
Population in basin (people)	621,752
Country at mouth	Guatemala
Average rainfall (mm/year)	1,739

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
PAZX_GTM		1,022.14				
PAZX_SLV		775.41				
Total in Basin	1.87	857.54			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
PAZX_GTM	26.76	3.72	3.73	6.37	5	8.39	116.32	
PAZX_SLV	113.80	38.60	3.40	32.36	8	31.03	290.50	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	140.55	42.32	7.13	38.73	12.95	39.42	226.06	7.53

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
PAZX_GTM	1	0.56	230	189.50	2.47			0	3,477.89	0	0.00
PAZX_SLV	1	0.44	392	406.73	0.47	0.00	100.00	0	3,826.08	0	0.00
Total in Basin	2	1.00	622	285.61	1.36	0.00	63.00	0	3,697.26	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PAZX_GTM	1		2		5	1			2	5	2	4	1	3	2
PAZX_SLV	1		2		5	1			2	5	2	5	3	3	2
River Basin	1		2	4	5				1	5	2	5	2	3	2

Indicators

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
PAZX_GTM	2	3							2
PAZX_SLV	3	3							2
River Basin	2	4			5	5			2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

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Pedernales Basin

Geography

Total drainage area (km^2)	320
No. of countries in basin	2
BCUs in basin	Dominican Republic (DOM), Haiti (HTI)
Population in basin (people)	22,958
Country at mouth	Dominican Republic, Haiti
Average rainfall (mm/year)	

Governance

No. of treaties and agreements[1]	2
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
PDNL_DOM						
PDNL_HTI						
Total in Basin					0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
PDNL_DOM								
PDNL_HTI								

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin								

Socioeconomic Geography

BCU	Area ('000 km²)	BCU area in basin (%)	Population ('000 people)	Population density (people/km²)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km²)
PDNL_DOM	0	0.48	4	25.12	1.38	0.00	100.00	0	5,826.13	0	0.00
PDNL_HTI	0	0.52	19	114.58	1.34			0	819.90	0	0.00
Total in Basin	0	1.00	23	71.83	1.37	0.00	16.71	0	1,656.46	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PDNL_DOM					5				3	3	2		1	3	1
PDNL_HTI		1			5				3	3	2	5	1	5	1
River Basin		1			5				3	3	2		1	4	1

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
PDNL_DOM									2
PDNL_HTI			2	2			2	3	2
River Basin			2	2			2	3	2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin					

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Rio Grande (North America) Basin

Geography

Total drainage area (km^2)	538,402
No. of countries in basin	2
BCUs in basin	Mexico (MEX), United States (USA)
Population in basin (people)	10,968,793
Country at mouth	Mexico
Average rainfall (mm/year)	440

Governance

No. of treaties and agreements[1]	23
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	12
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
RGNA_MEX		25.79			687.83	8.69
RGNA_USA		20.01			536.57	8.03
Total in Basin	12.11	22.50			1,224.40	16.72

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
RGNA_MEX	8,114.88	6,704.13	51.05	99.06	268	992.53	1,041.93	
RGNA_USA	10,744.97	8,783.00	42.04	611.59	357	951.57	3,378.38	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	18,859.84	15,487.13	93.10	710.66	624.86	1,944.11	1,719.41	155.68

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
RGNA_MEX	224	0.42	7,788	34.81	1.26	0.00	100.00	17	10,307.28	10	44.69
RGNA_USA	315	0.58	3,181	10.11	0.89	7.48	92.52	4	53,142.89	25	79.45
Total in Basin	538	1.00	10,969	20.37	1.07	2.17	97.83	21	22,727.90	35	65.01

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
RGNA_MEX	4	5	5		4	1	5	4	2	2	1	2	3	2	5
RGNA_USA	5	5	5		2	2	5	4	1	2	1	2	1	2	5
River Basin	5	5	5	3	3	2	5	4	1	2	1	2	2	3	5

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low Low Medium High Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**P-2030**	**P-2050**	**Projected**
RGNA_MEX	5	5	5	5			1	2	2
RGNA_USA	5	5	5	5			1	2	1
River Basin	5	5	5	5	3	3	1	2	2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	4	5	1	3	3

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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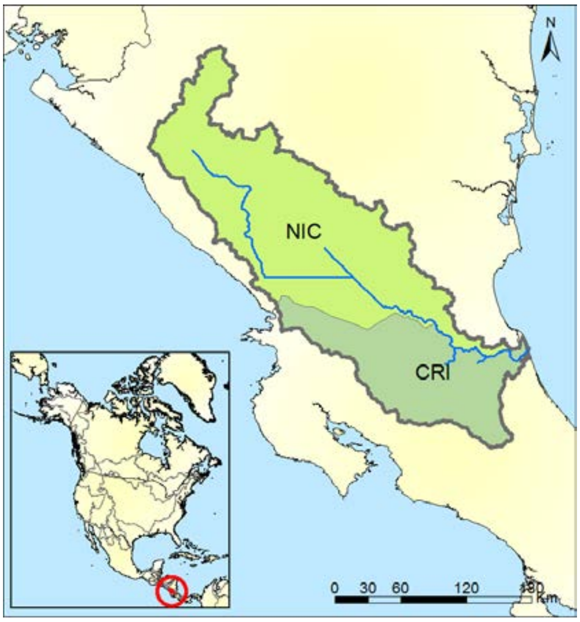
San Juan Basin



Geography

Total drainage area (km^2)	41,360
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Nicaragua (NIC)
Population in basin (people)	3,443,189
Country at mouth	Nicaragua
Average rainfall (mm/year)	2,287

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	4
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
SJUA_CRI		1,885.66			191.50	3.88
SJUA_NIC		827.19			8,875.30	112.31
Total in Basin	50.18	1,213.26			9,066.80	116.19

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
SJUA_CRI	724.76	54.56	1.33	4.61	224	440.58	755.11	
SJUA_NIC	382.90	155.24	14.83	69.81	29	113.88	154.19	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	1,107.66	209.81	16.16	74.42	252.82	554.45	321.70	2.21

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
SJUA_CRI	13	0.32	960	73.03	1.56	0.00	100.00	0	10,184.61	1	76.09
SJUA_NIC	28	0.68	2,483	88.01	1.30	0.00	100.00	1	1,851.11	0	0.00
Total in Basin	41	1.00	3,443	83.25	1.45	0.00	100.00	1	4,174.09	1	24.18

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
SJUA_CRI	1	1	2		5	5	4	2	3	5	5	3	3	2	2
SJUA_NIC	1	1	2		5	5	3	2	2	5	5	5	5	3	2
River Basin	1	1	2	3	5	5	3	2	3	5	5	4	5	3	2

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
SJUA_CRI	2	2	1	1			1	2	5
SJUA_NIC	2	3	1	1			2	2	5
River Basin	2	3	1	1	3	4	2	2	5

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	**17**	**18**	**19**	**20**	**21**
River Basin	4				

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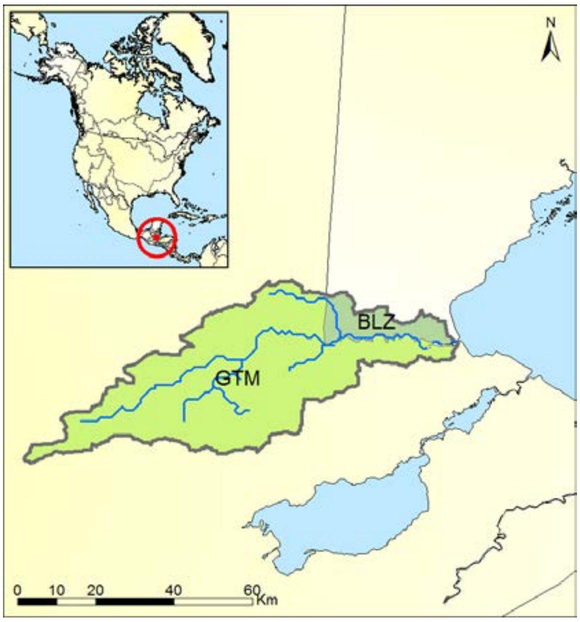
Sarstun Basin



Geography

Total drainage area (km^2)	2,165
No. of countries in basin	2
BCUs in basin	Belize (BLZ), Guatemala (GTM)
Population in basin (people)	77,911
Country at mouth	Belize, Guatemala
Average rainfall (mm/year)	

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
SRTU_BLZ						
SRTU_GTM						
Total in Basin					0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
SRTU_BLZ								
SRTU_GTM								

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Total in Basin									

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
SRTU_BLZ	0	0.10	2	11.10	2.07			0	4,834.29	0	0.00
SRTU_GTM	2	0.90	75	38.81	2.47			0	3,477.89	0	0.00
Total in Basin	2	1.00	78	35.99	2.52	0.00	0.00	0	3,520.50	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
SRTU_BLZ					5	1			3	5	3	4	1	2	4
SRTU_GTM					5	1			3	5	3	4	1	3	2
River Basin				2	5				3	5	3	4	1	3	2

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
SRTU_BLZ									3
SRTU_GTM									3
River Basin					3	3			3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin					

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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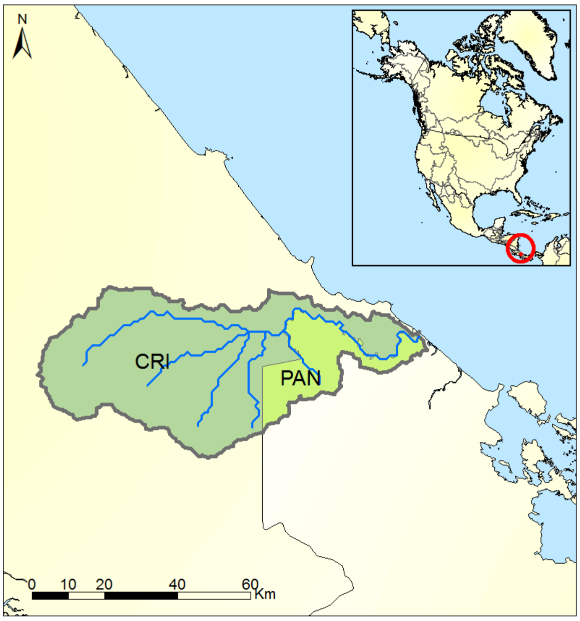
Sixaola Basin



Geography

Total drainage area (km^2)	2,857
No. of countries in basin	2
BCUs in basin	Costa Rica (CRI), Panama (PAN)
Population in basin (people)	48,109
Country at mouth	Costa Rica, Panama
Average rainfall (mm/year)	3,161

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	1
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
SIOL_CRI		2,212.31				
SIOL_PAN		441.66				
Total in Basin	4.63	1,622.38			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
SIOL_CRI	48.56	3.92	0.20	0.00	6	38.82	1,290.49	
SIOL_PAN	5.85	0.00	0.02	0.00	0	5.82	557.82	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	54.41	3.92	0.22	0.00	5.62	44.64	1,130.88	1.17

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
SIOL_CRI	2	0.82	38	16.12	1.56			0	10,184.61	0	0.00
SIOL_PAN	1	0.18	10	20.09	1.65			0	11,036.81	0	0.00
Total in Basin	3	1.00	48	16.84	1.43	0.00	0.00	0	10,370.26	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SIOL_CRI	1		2		5	2			3	5	2	3	1	2	3
SIOL_PAN	1		1		4	2			3	5	2	3	1	3	4
River Basin	1		2	2	5				2	5	2	3	1	3	4

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Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
SIOL_CRI	3	3							2
SIOL_PAN	3	3							2
River Basin	3	3			2	2			2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

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Suchiate Basin

Geography

Total drainage area (km²)	1,409
No. of countries in basin	2
BCUs in basin	Guatemala (GTM), Mexico (MEX)
Population in basin (people)	340,484
Country at mouth	Guatemala, Mexico
Average rainfall (mm/year)	2,493

Governance

No. of treaties and agreements[1]	1
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km³/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km³/year)	Av. Groundwater Discharge (km³/year)	Lake and Reservoir Surface Area (km²)	Lake and Reservoir Volume (km³)
SUCT_GTM		1,848.13				
SUCT_MEX		1,282.30				
Total in Basin	2.07	1,471.05			0.00	0.00

Water Withdrawals

BCU	Total (km³/year)	Irrigation (km³/year)	Livestock (km³/year)	Electricity (km³/year)	Manufacture (km³/year)	Domestic (km³/year)	Per capita (m³/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
SUCT_GTM	63.51	5.61	2.91	15.26	21	18.61	224.75	
SUCT_MEX	203.79	34.35	1.39	0.00	42	126.35	3,519.00	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	267.30	39.96	4.30	15.26	62.83	144.95	785.06	12.89

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
SUCT_GTM	1	0.78	283	258.28	2.47			0	3,477.89	0	0.00
SUCT_MEX	0	0.22	58	183.66	1.26	0.00	100.00	0	10,307.28	0	0.00
Total in Basin	1	1.00	340	241.58	2.30	0.00	17.01	0	4,639.48	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
SUCT_GTM	1		2		5	4			3	4	2	4	1	3	2
SUCT_MEX	1		2		4	4			3	4	2	2	1	2	3
River Basin	1		2	4	5				2	4	2	3	1	3	3

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
SUCT_GTM	2	3							2
SUCT_MEX	2	3							2
River Basin	2	3			4	4			2

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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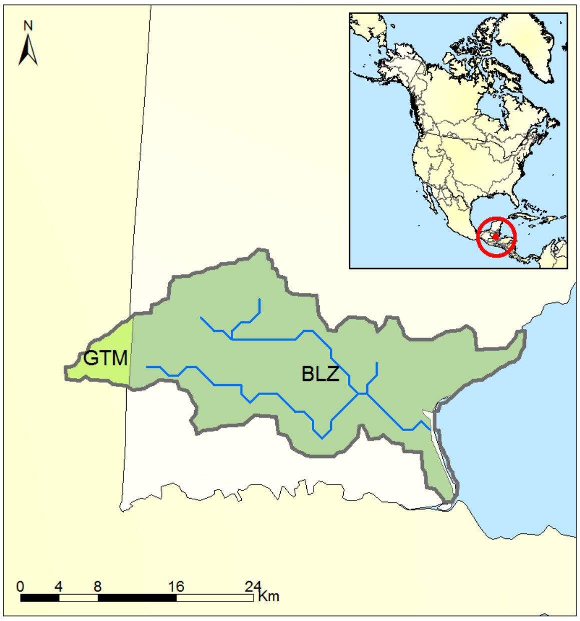

Geography

Total drainage area (km^2)	472
No. of countries in basin	2
BCUs in basin	Belize (BLZ), Guatemala (GTM)
Population in basin (people)	3,261
Country at mouth	Belize
Average rainfall (mm/year)	3,075

Governance

No. of treaties and agreements[1]	0
No. of RBOs and Commissions[2]	0

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	0
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
TEMA_BLZ		1,534.08				
TEMA_GTM						
Total in Basin	0.72	1,534.08			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
TEMA_BLZ	89.59	9.40	2.74	73.65	0	3.79	35,658.81	
TEMA_GTM								

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
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Total in Basin	89.59	9.40	2.74	73.65	0.00	3.79	27,468.52	12.37

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000.000 km^2)
TEMA_BLZ	0	0.94	3	5.63	2.07			0	4,834.29	0	0.00
TEMA_GTM	0	0.06	1	28.46	2.47			0	3,477.89	0	0.00
Total in Basin	0	1.00	3	6.91	2.42	0.00	0.00	0	4,522.74	0	0.00

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
TEMA_BLZ	1		2		5	1			1	5	3	4	3	2	2
TEMA_GTM					5				1	5	3	4	1	3	1
River Basin	1		2	2	5				2	5	3	4	3	2	1

Indicators

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Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
TEMA_BLZ	3	3							3
TEMA_GTM									3
River Basin	3	3			2	2			3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	1				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

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Tijuana Basin

Geography

Total drainage area (km^2)	4,430
No. of countries in basin	2
BCUs in basin	Mexico (MEX), United States (USA)
Population in basin (people)	1,067,632
Country at mouth	XXX
Average rainfall (mm/year)	341

Governance

No. of treaties and agreements[1]	9
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	1
Large Marine Ecosystems	1

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
TIJU_MEX		68.21				
TIJU_USA		115.67				
Total in Basin	0.41	91.88			0.00	0.00

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
TIJU_MEX	572.25	287.83	2.12	0.00	71	211.08	619.48	
TIJU_USA	844.05	89.46	1.60	30.91	249	473.56	5,866.32	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
[2] For details on River Basin Organisations (RBOs) and Commissions please visit http://www.transboundarywaters.orst.edu/

Total in Basin	1,416.30	377.29	3.73	30.91	319.73	684.65	1,326.58	347.98

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
TIJU_MEX	3	0.72	924	289.21	1.26	0.00	100.00	1	10,307.28	2	626.17
TIJU_USA	1	0.28	144	116.42	0.89	5.27	94.73	0	53,142.89	2	1,618.36
Total in Basin	4	1.00	1,068	241.01	1.15	0.71	99.29	1	16,080.07	4	902.97

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TIJU_MEX	5	5	4		4		3	4	2	2	1	2	1	2	5
TIJU_USA	5		3		2				2	2	1	2	1	2	5
River Basin	5	5	3	5	3		4	5	2	2	1	2	1	3	5

Indicators

1 - Environmental water stress **2** – Human water stress **3** – Agricultural water stress **4** – Nutrient pollution **5** – Wastewater pollution **6** – Wetland disconnectivity **7** – Ecosystem impacts from dams **8** – Threat to fish **9** – Extinction risk **10** – Legal framework **11** – Hydropolitical tension **12** – Enabling environment **13** – Economic dependence on water resources **14** – Societal well-being **15** – Exposure to floods and droughts

Very low	Low	Medium	High	Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
TIJU_MEX	5	5	5	5			1	2	1
TIJU_USA	5	5							1
River Basin	5	5	5	5	5	5	1	2	1

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	5				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

Indicators

17 – Lake influence indicator **18** – Relative sea level rise (RSLR) **19** – Wetland ecological threat **20** – Population pressure **21** – Delta governance

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Yaqui Basin

Geography

Total drainage area (km^2)	72,879
No. of countries in basin	2
BCUs in basin	Mexico (MEX), United States (USA)
Population in basin (people)	559,911
Country at mouth	Mexico
Average rainfall (mm/year)	541

Governance

No. of treaties and agreements[1]	3
No. of RBOs and Commissions[2]	1

Geographical Overlap with Other Transboundary Systems

(No. of overlapping water systems)

Groundwater	
Lakes	2
Large Marine Ecosystems	0

A BCU (Basin Country Unit) is defined as the portion of a country within a particular river basin.
All BCUs have a BCU code which includes a Basin Code of four letters and a Country Code of three letters: XXXX-XXX

Water Resources

BCU	Annual Discharge (km^3/year)	Annual Runoff (mm/year)	Av. Groundwater Recharge (km^3/year)	Av. Groundwater Discharge (km^3/year)	Lake and Reservoir Surface Area (km^2)	Lake and Reservoir Volume (km^3)
YAQU_MEX		50.21			292.70	1.91
YAQU_USA		31.37				
Total in Basin	3.59	49.29			292.70	1.91

Water Withdrawals

BCU	Total (km^3/year)	Irrigation (km^3/year)	Livestock (km^3/year)	Electricity (km^3/year)	Manufacture (km^3/year)	Domestic (km^3/year)	Per capita (m^3/year)	Total withdrawal as a % of Total Actual Renewable Water Resources (%)
YAQU_MEX	2,036.49	1,929.06	9.02	9.93	7	81.09	3,850.66	
YAQU_USA	83.90	79.91	0.18	0.00	0	3.81	2,702.74	

[1] For details on Treaties and Agreements please see http://www.transboundarywaters.orst.edu/
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Total in Basin	2,120.39	2,008.97	9.21	9.93	7.38	84.90	3,787.01	59.03

Socioeconomic Geography

BCU	Area ('000 km^2)	BCU area in basin (%)	Population ('000 people)	Population density (people/ km^2)	Annual pop. growth (%)	Rural population ratio (% pop. rural)	Urban population ratio (% pop. urban)	Large Cities (>500 ,000)	GDP per capita (USD)	No. of dams	Dam Density (No./000 .000 km^2)
YAQU_MEX	69	0.94	529	7.70	1.26	0.00	100.00	0	10,307.28	3	43.67
YAQU_USA	4	0.06	31	7.42	0.89	9.77	90.23	0	53,142.89	0	0.00
Total in Basin	73	1.00	560	7.68	1.19	0.54	99.46	0	12,682.26	3	41.16

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Indicator[3]

Thematic group	Water Quantity			Water Quality			Ecosystems			Governance			Socioeconomics		
BCU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
YAQU_MEX	3	2	3		4	1	5	3	1	3	2	2	1	2	3
YAQU_USA	5	5	4		2				1	3	2	2	1	2	5
River Basin	3	2	3	3	4	1	5	3	1	3	2	2	1	3	3

Indicators

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Very low | Low | Medium | High | Very high

TWAP RB Assessment Results: BCU and Basin Relative Risk Category per Projected Indicator

Projected Indicator	1.Environmental water stress		2.Human water stress		4.Nutrient pollution		16.Change in population density		11.Hydropolitical tension
Basin BCU	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	P-2030	P-2050	Projected
YAQU_MEX	5	5	3	3			1	2	3
YAQU_USA	5	5	5	5			1	1	2
River Basin	5	5	3	3	3	3	1	2	3

TWAP RB Assessment results: Water System Linkages

Thematic group	Lake Influence Indicator	Delta Vulnerability Index			
Basin/Delta	17	18	19	20	21
River Basin	2				

[3] Lined (or dotted) cells indicate a lower degree of confidence in results due to global modelling limitations and other gap-filling methods.

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Alejandro Linares Garcia, Wikimedia Commons

1. LME 05 – Gulf of Mexico
2. LME 11 – Pacific Central American Coastal
3. LME 12 – Caribbean Sea

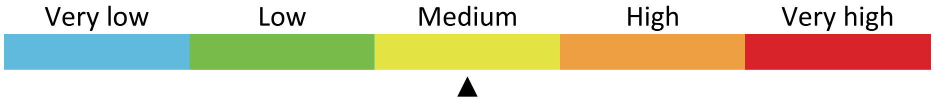
LME 05 – Gulf of Mexico

Bordering countries: Mexico, United States of America
LME Total area: 1,530,387 km^2

List of indicators

LME overall risk

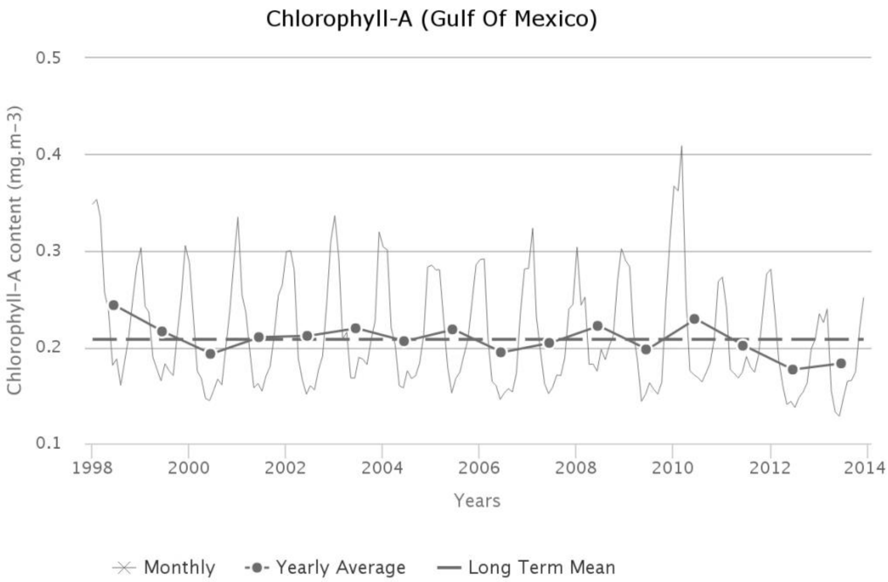
This LME falls in the cluster of LMEs that exhibit medium numbers of collapsed and overexploited fish stocks, as well as very high proportions of catch from bottom impacting gear.
Based on a combined measure of the Human Development Index and the averaged indicators for fish & fisheries and pollution & ecosystem health modules, the overall risk factor is medium.

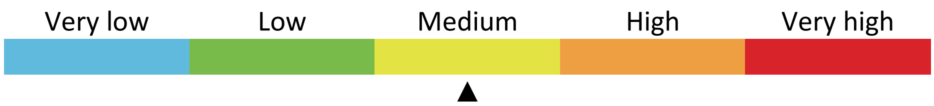


Productivity

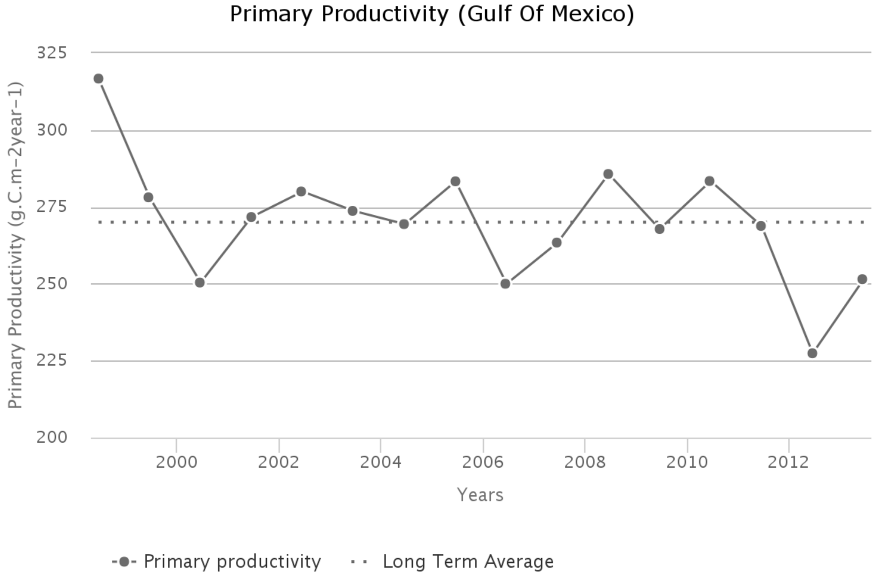
Chlorophyll-A

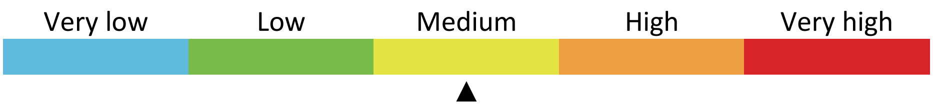
The annual Chlorophyll a concentration (CHL) cycle has a maximum peak (0.297 mg.m^{-3}) in January and a minimum (0.159 mg.m^{-3}) during June. The average CHL is 0.208 mg.m^{-3}. Maximum primary productivity (317 g.C.m^{-2}.y^{-1}) occurred during 1998 and minimum primary productivity (227 g.C.m^{-2}.y^{-1}) during 2012. There is a statistically insignificant decreasing trend in Chlorophyll of -0.221 % from 2003 through 2013. The average primary productivity is 270 g.C.m^{-2}.y^{-1}, which places this LME in Group 3 of 5 categories (with 1 = lowest and 5= highest)





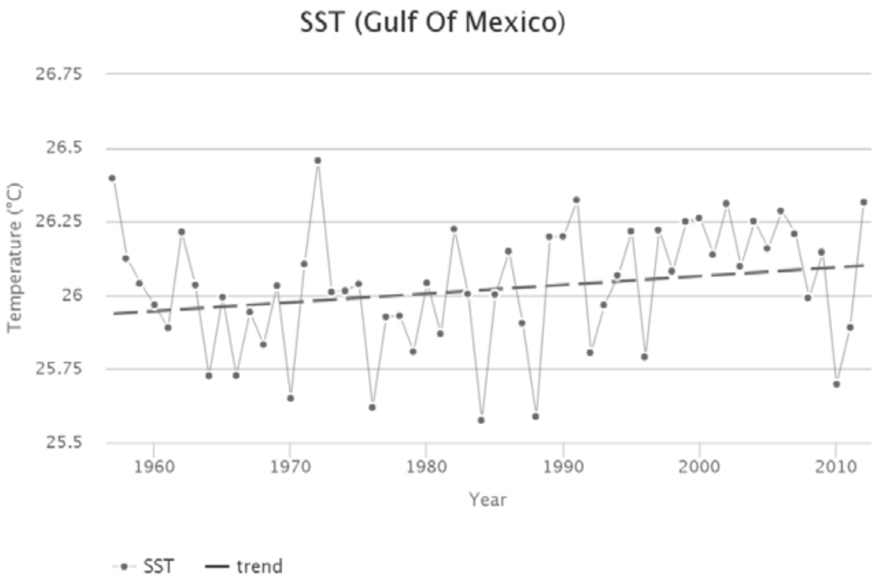
Primary productivity





Sea Surface Temperature

Between 1957 and 2012, the Gulf of Mexico LME #5 has warmed by 0.16, thus belonging to Category 4 (slow warming LME). The Gulf of Mexico's thermal history is quite peculiar. The global cooling of the 1960s transpired as an SST drop of <1°C, followed by a slow warming until present. The relatively slow warming of the last 50 years was modulated by strong interannual variability with a typical magnitude of 0.5°C. The all-time high of >26.4°C in 1972 was a major event as SST increased by 0.8°C in just two years. This event was localized within the Gulf of Mexico LME. The relative stability of the Gulf of Mexico's thermal regime can be explained by the Gulf Stream (Loop Current) flowing through the Gulf of Mexico.

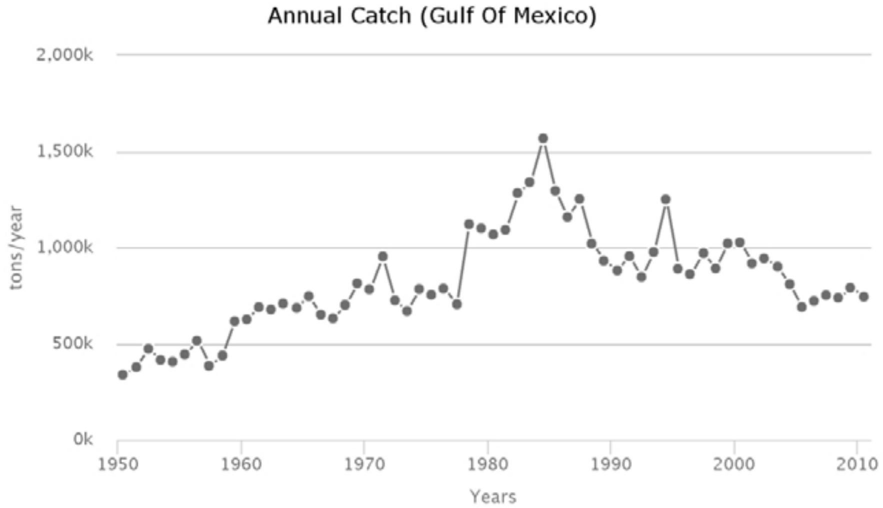


Fish and Fisheries

The Gulf of Mexico LME fisheries are multispecies, multigear and multifleet in character and include artisanal, commercial and recreational fishing. Species of economic importance include brown shrimp (*Penaeus aztecus*), white shrimp (*Penaeus setiferus*), pink shrimp (*Penaeus duorarum*), Gulf menhaden (*Brevoortia patronus*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculatus*), red grouper (*Epinephelus morio*), red snapper (*Lutjanus campechanus*), seatrout, tuna and billfish

Annual Catch

Total reported landings showed an increase to over 1.6 million t in 1984, followed by a decline to 750,000 t in recent years.

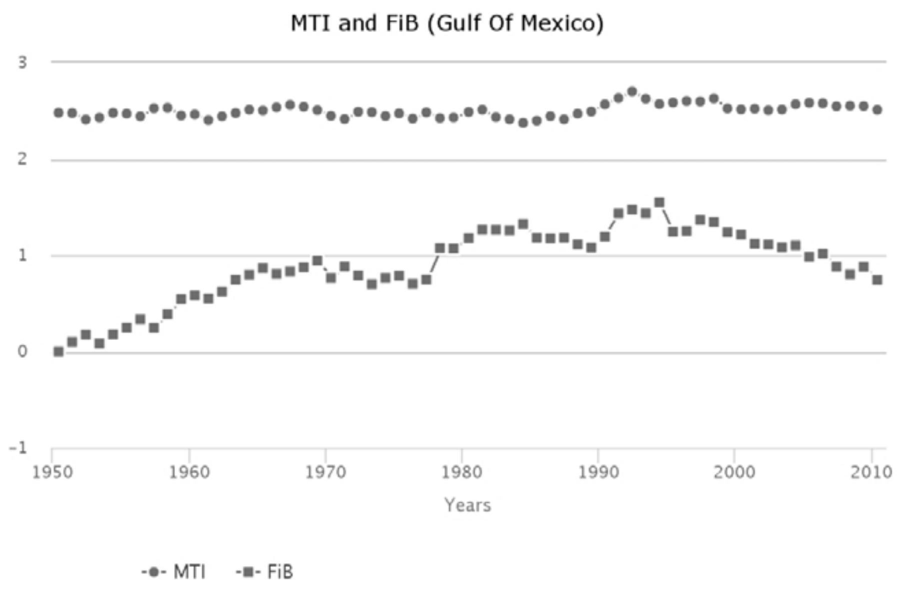


Catch value

In 1981, the annual value of the reported landings was over 2.4 billion US$ (in 2005 value).

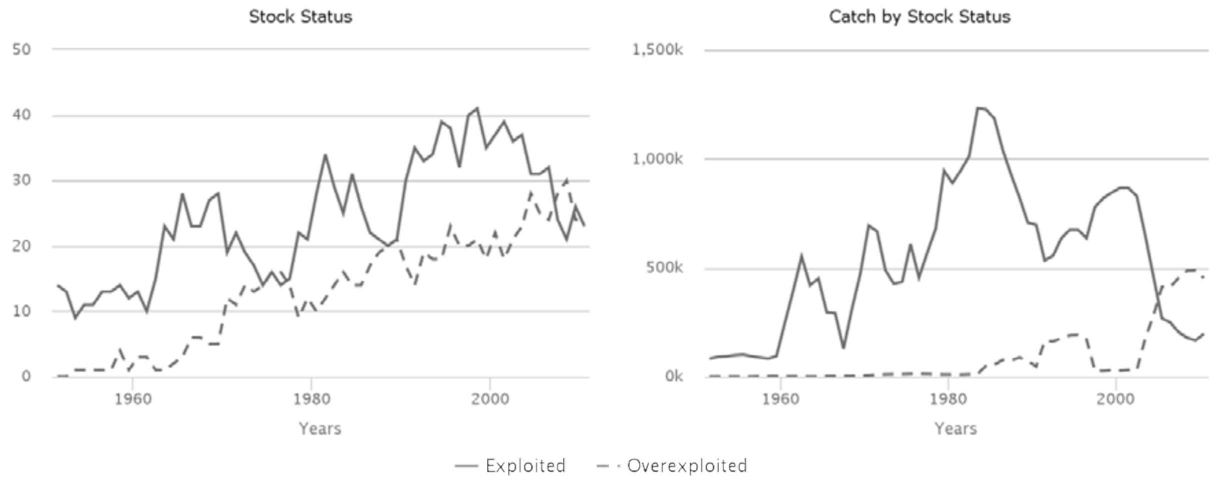
Marine Trophic Index and Fishing-in-Balance index

The MTI has increased slightly from the early 1950s to 2010. The very low value of the MTI (2.4-2.5) is due to the high proportion of small, low trophic-level fishes, especially Gulf menhaden and shrimps in the landings, and the exclusion of the shrimp trawler bycatch in estimating mean trophic levels. The decline of the FiB index from the mid-1980s is likely a result of the declining reported landings.



Stock status

The Stock-Catch Status Plots indicate that collapsed and overexploited stocks now account for about 60% of all commercially exploited stocks in the LME, with overexploited stocks contributing almost 70% of the reported landings.

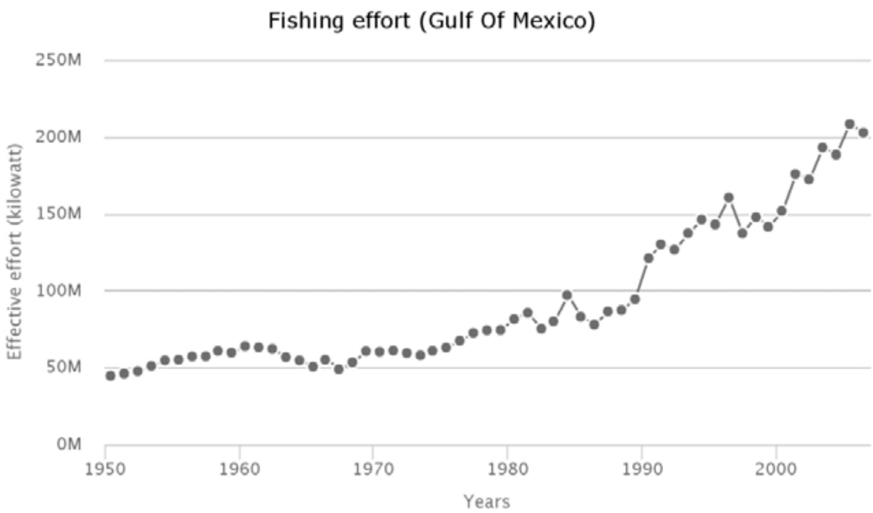


Catch from bottom impacting gear

The percentage of catch from the bottom gear type to the total catch reaches its first maximum at 72% in 1953 and then this percentage declined steadily to around 19% in the 1970s. This percentage then further declined to around 10% in the recent decade.

Fishing effort

The total effective effort increased from around 2 million kW in the 1950s to its peak at 200 million kW in the mid- 2000s.



Primary Production Required

The primary production required (PPR) to sustain the reported landings in the LME reached 8% of the observed primary production in 1994, but this is probably an underestimate due to the high level of shrimp bycatch absent from the underlying statistics.

Pollution and Ecosystem Health

Pollution

Nutrient ratio, Nitrogen load and Merged Indicator

Human activities in watersheds are affecting nutrients transported by rivers into LMEs. Large amounts of nutrients (in particular*nitrogen load*) entering coastal waters of LMEs can result in high biomass algal blooms, leading to hypoxic or anoxic conditions, increased turbidity and changes in community composition, among other effects. In addition, changes in the *ratio of nutrients*entering LMEs can result in dominance by algal species that have deleterious effects (toxic, clog gills of shellfish, etc.) on ecosystems and humans. An overall nutrient indicator (*Merged Nutrient Indicator*) based on 2 sub-indicators: Nitrogen Load and Nutrient Ratio (ratio of dissolved Silica to Nitrogen or Phosphorus - the Index of Coastal Eutrophication Potential or ICEP) was calculated.

Nitrogen load

The Nitrogen Load risk level for contemporary (2000) conditions was very high. (level 5 of the five risk categories, where 1 = lowest risk; 5 = highest risk). Based on a “current trends” scenario (Global Orchestration), this remained the same in 2030 and 2050.

Nutrient ratio

The Nutrient Ratio (ICEP) risk level for contemporary (2000) conditions was high (4). According to the Global Orchestration scenario, this remained the same in 2030 and 2050.

Merged nutrient indicator

The risk level for the Merged Nutrient Indicator for contemporary (2000) conditions was very high (5). According to the Global Orchestration scenario, this remained the same in 2030 and 2050.

2000			2030			2050		
Nitrogen load	Nutrient ratio	Merged nutrient indicator	Nitrogen load	Nutrient ratio	Merged nutrient indicator	Nitrogen load	Nutrient ratio	Merged nutrient indicator
5	4	5	5	4	5	5	4	5

Legend:

Very low Low Medium High Very high

POPs

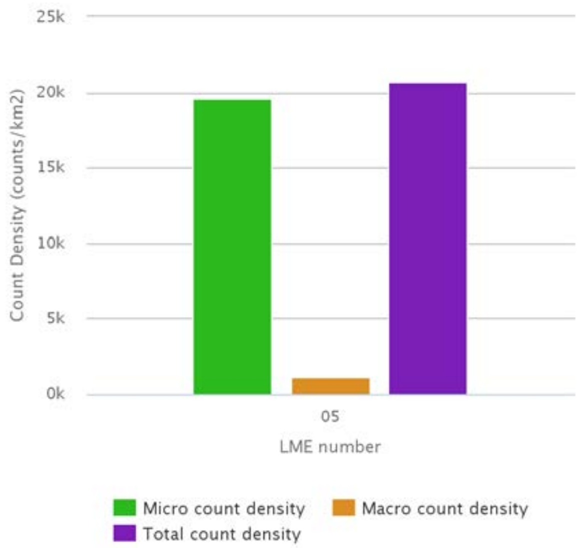
Data are available for only one sample at a rural location in Mississippi State (USA). The location shows a concentration (ng.g^{-1} of pellets) of 28 for PCBs, 13 for DDTs, and 0.1 for HCHs. These correspond to risk category 2 for PCBs, 2 for DDTs, and 1 for HCHs, of the five risk categories (1 = lowest risk; 5 = highest risk). This is probably due to minimal anthropogenic activities involving the use of POPs (PCBs in industries and DDT and HCH pesticides in agriculture). More samples and locations are necessary to properly evaluate this LME.

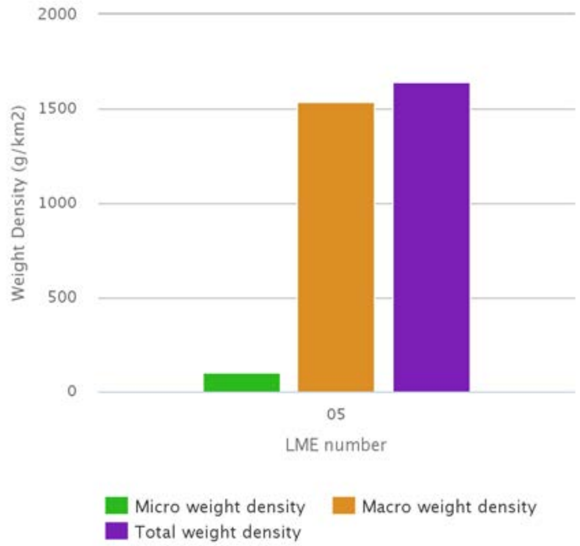
	PCBs		DDTs		HCHs	
Locations	Avg. (ng/g)	Risk	Avg. (ng/g)	Risk	Avg. (ng/g)	Risk
1	28	2	13	2	0.1	1

Legend: Very low, Low, Medium, High, Very high

Plastic debris

Modelled estimates of floating plastic abundance (items km^{-2}), for both micro-plastic (<4.75 mm) and macro-plastic (>4.75 mm), indicate that this LME is in the group with relatively high levels of plastic concentration. Estimates are based on three proxy sources of litter: shipping density, coastal population density and the level of urbanisation within major watersheds, with enhanced run-off. The high values are due to the relative importance of these sources in this LME. The abundance of floating plastic in this category is estimated to be on average over 100 times higher that those LMEs with lowest values. There is limited evidence from sea-based direct observations and towed nets to support this conclusion.





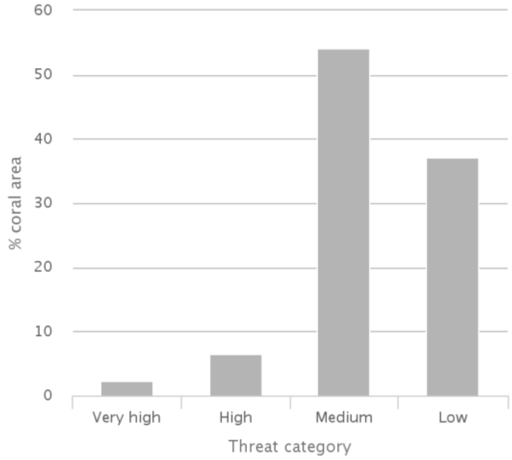
Ecosystem Health

Mangrove and coral cover

0.36% of this LME is covered by mangroves (US Geological Survey, 2011) and 0.09% by coral reefs (Global Distribution of Coral Reefs, 2010).

Reefs at risk

This LME has a present (2011) integrated threat index (combining threat from overfishing and destructive fishing, watershed-based and marine-based pollution and damage) of 174. 2% of coral reefs cover is under very high threat, and 6% under high threat (of the 5 possible threat categories, from low to critical). When combined with past thermal stress (between 1998 and 2007), these values increase to 8% and 19% for very high and high threat categories respectively. By year 2030, 7% of coral cover in this LME is predicted to be under very high to critical level of threat from warming and acidification; this proportion increases to 9% by 2050.

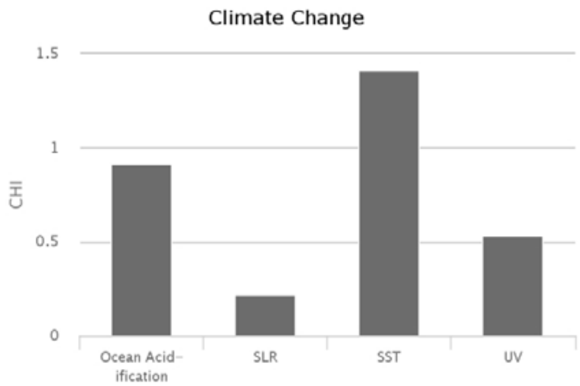


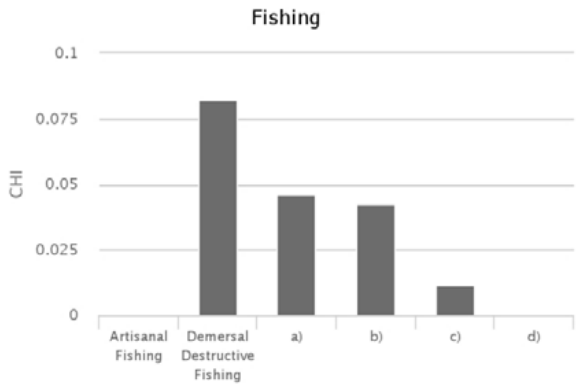
Marine Protected Area change

The Gulf of Mexico LME experienced an increase in MPA coverage from 6,671 km^2 prior to 1983 to 290,795 km^2 by 2014. This represents an increase of 4,259%, within the medium category of MPA change.

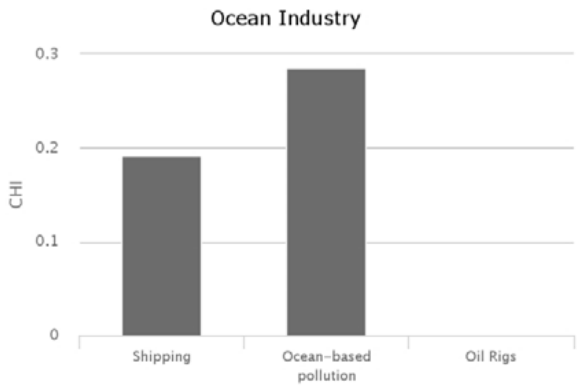
Cumulative Human Impact

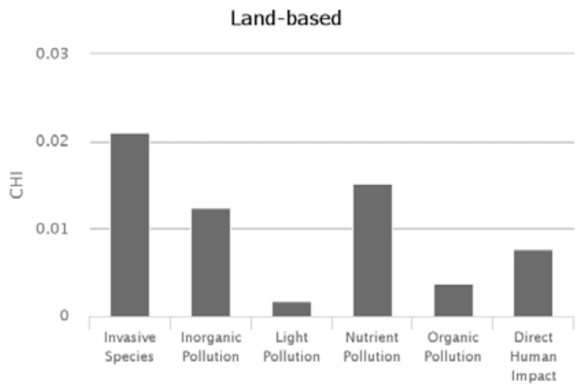
The Gulf of Mexico LME experiences an above average overall cumulative human impact (score 3.81; maximum LME score 5.22), which is well above the LME with the least cumulative impact. It falls in risk category 3 of the five risk categories (1 = lowest risk; 5 = highest risk). This LME is most vulnerable to climate change. Of the 19 individual stressors, three connected to climate change have the highest average impact on the LME: ocean acidification (0.92; maximum in other LMEs was 1.20), UV radiation (0.53; maximum in other LMEs was 0.76), and sea surface temperature (1.41; maximum in other LMEs was 2.16). Other key stressors include commercial shipping, sea level rise, ocean based pollution, and demersal destructive commercial fishing.

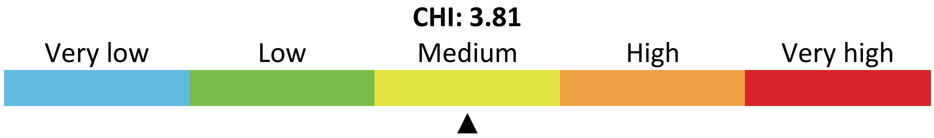




a) Demersal Non-destructive High Bycatch Fishing
c) Pelagic High Bycatch Fishing
b) Demersal Non-destructive Low Bycatch Fishing
d) Pelagic Low Bycatch Fishing

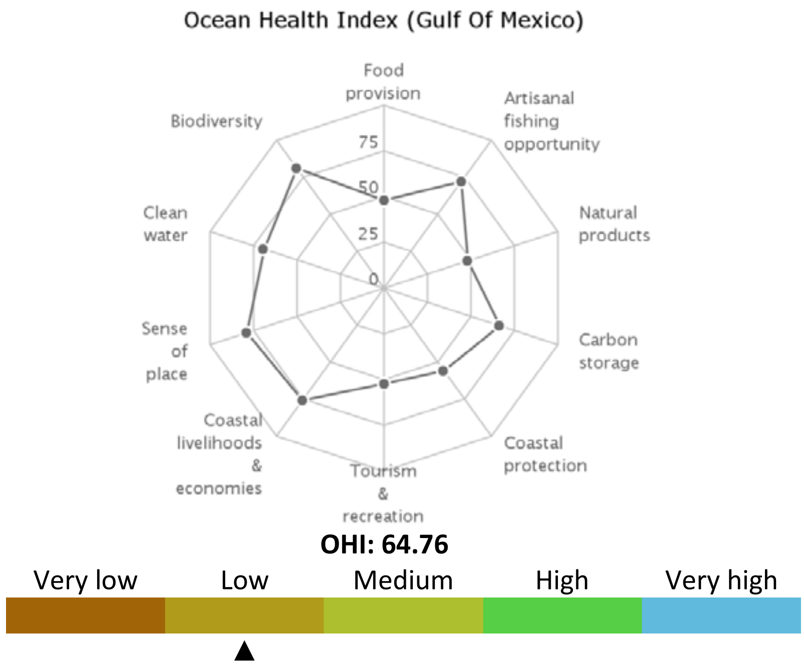






Ocean Health Index

The Gulf of Mexico LME scores above average on the Ocean Health Index compared to other LMEs (score 71 out of 100; range for other LMEs was 57 to 82) but still relatively low. This score indicates that the LME is well below its optimal level of ocean health, although there are some aspects that are doing well. Its score in 2013 increased 5 points compared to the previous year, due in large part to changes in the scores for clean waters and natural products. This LME scores lowest on food provision, coastal protection, coastal livelihoods, and iconic species goals and highest on artisanal fishing opportunities, coastal economies, lasting special places and species diversity goals. It falls in risk category 3 of the five risk categories, which is an average level of risk (1 = lowest risk; 5 = highest risk).



Socio-economics

Indicators of demographic trends, economic dependence on ecosystem services, human wellbeing and vulnerability to present-day extreme climate events and projected sea level rise, are assessed for the Gulf of Mexico LME. To compare and rank LMEs, they were classified into five categories of risk (from 1 to 5, corresponding to lowest, low, medium, high and highest risk, respectively) based on the values of the individual indicators. In the case of economic revenues, the LMEs were grouped to 5 classes of revenues from lowest, low, medium, high and highest, as revenues did not translate to risk.

Population

The coastal area includes the southern coast of the United States of America and the eastern shoreline of Mexico. Covering about 140,753 km^2, current and projected population in 2100 are both in the large population size category (high risk) with a density of 81 persons per km^2 in 2010 and increasing to 129 per km^2 in 2100. About 24% of coastal population lives in rural areas, and is projected to decrease slightly to 23% in 2100.

Total population		Rural population	
2010	2100	2010	2100
40,522,728	64,430,109	9,748,728	14,849,820

Legend: Very low, Low, Medium, High, Very high

Coastal poor

The indigent population makes up 31% of the LME's coastal dwellers. The Gulf of Mexico places in the highest-risk category based on percentage and absolute number of coastal poor (present day estimate).

Coastal poor
12,438,783

Revenues and Spatial Wealth Distribution

Fishing and tourism depend on ecosystem services provided by LMEs. The Gulf of Mexico LME ranks in the high revenue category in fishing revenues based on yearly average total ex-vessel price of US

2013 $1.7 billion (thousand million) for the period 2001-2010. Fish protein accounts for 8% of the total animal protein consumption of the coastal population. Its yearly average tourism revenue for 2004-2013 of US 2013 $252 billion places it in the highest revenue category. On average, LME-based tourism income contributes 9% to the national GDPs of the LME coastal states. Spatial distribution of economic activity (e.g. spatial wealth distribution) measured by night-light and population distribution as coarse proxies can range from 0.0000 (totally equal distribution and lowest risk) to 1.0000 (concentrated in 1 place and most inequitable and highest risk). The Night Light Development Index (NLDI) thus indicates the level of spatial economic development, and that for the Gulf of Mexico LME falls in the category with lowest risk.

Fisheries Annual Landed Value	% Fish Protein Contribution	Tourism Annual Revenues	% Tourism Contribution to GDP	NLDI
1,664,680,557	7.6	252,343,000,000	9.0	0.6416

Legend: Very low, Low, Medium, High, Very high

Human Development Index

Using the Human Development Index (HDI) that integrates measures of health, education and income, the present-day Gulf of Mexico LME HDI belongs to the highest HDI and lowest risk category. Based on an HDI of 0.856, this LME has an HDI Gap of 0.144, the difference between present and highest possible HDI (1.000). The HDI Gap measures an overall vulnerability to external events such as disease or extreme climate related events, due to less than perfect health, education, and income levels, and is independent of the harshness of and exposure to specific external shocks.

HDI values are projected to the year 2100 in the contexts of shared socioeconomic development pathways (SSPs). The Gulf of Mexico LME is projected to maintain its position in the lowest risk category (highest HDI) in 2100 under a sustainable development pathway or scenario. Under a fragmented world scenario, this LME is projected to slip to the high risk category (low HDI) because of reduced income level and bigger population size compared to estimated income and population values in a sustainable development pathway.

	HDI 2100	
HDI	SSP1	SSP3
0.8563	0.9528	0.6671

Legend: Very low, Low, Medium, High, Very high

Climate-Related Threat Indices

The Climate-Related Threat Indices utilize the HDI Gaps for present-day and projected 2100 scenarios. The contemporary climate index accounts for deaths and property losses due to storms, flooding and extreme temperatures incurred by coastal states during a 20-year period from 1994 to 2013 as hazard measures, the 2010 coastal population as proxy for exposure, and the present day HDI Gap as vulnerability measure.

The Contemporary Threat Index incorporates a Dependence Factor based on the fish protein contribution to dietary animal protein, and on the mean contribution of LME tourism to the national GDPs of LME coastal states. The HDI Gap and the degree of dependence on LME ecosystem services define the vulnerability of a coastal population. It also includes the average of risk related to extreme climate events, and the risk based on the degrading system states of an LME (e.g. overexploited fisheries, pollution levels, decrease in coastal ecosystem areas).

The 2100 sea level rise threat indices, each computed for the sustainable world and fragmented world development pathways, use the maximum projected sea level rise at the highest level of warming of 8.5 W/m2 in 2100 as hazard measure, development pathway-specific 2100 populations in

the 10 m × 10 km coast as exposure metrics, and development pathway-specific 2100 HDI Gaps as vulnerability estimates.
Present day climate threat index to the Gulf of Mexico LME is within the high-risk (high threat) category. The combined contemporaneous risk due to extreme climate events, degrading LME states and the level of vulnerability of the coastal population, is medium. In a sustainable development scenario, the risk index for sea level rise in 2100 is in the lowest risk category, and which increases to high-risk category under a fragmented world development pathway.

2010		2100	
Climate Threat	**Contemporary Threat**	**SSP1**	**SSP3**
0.6438	0.3387	0.3103	0.5847

Legend: Very low, Low, Medium, High, Very high

Governance

Governance architecture

In this LME, none of the transboundary arrangements for fisheries (OLDESPECA, WECAFC and ICCAT) appear to be closely connected. However, the arrangements for pollution and biodiversity within the LME are closely integrated within the Cartagena Convention. The specific biodiversity arrangement for turtles does not appear to be linked to any of the arrangements within the LME. Overall, no integrating mechanisms, such as an overall policy coordinating organisation for the LME, could be found. However, this is not to suggest that there is not an abundance of collaboration and interactions amongst the fisheries arrangements through participation in each other's meetings, complementing the integration found within the arrangements for pollution and biodiversity.
The overall scores for ranking of risk were:

Engagement	Completeness	Integration
71	**58**	**0.2**

Legend: Very low, Low, Medium, High, Very high

LME 11 – Pacific Central American Coastal

Bordering countries: Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru
LME Total area: 1,996,659 km^2

List of indicators

LME overall risk

This LME falls in the cluster of LMEs that exhibit low to medium levels of economic development (based on the night light development index) and medium levels of collapsed and overexploited fish stocks.

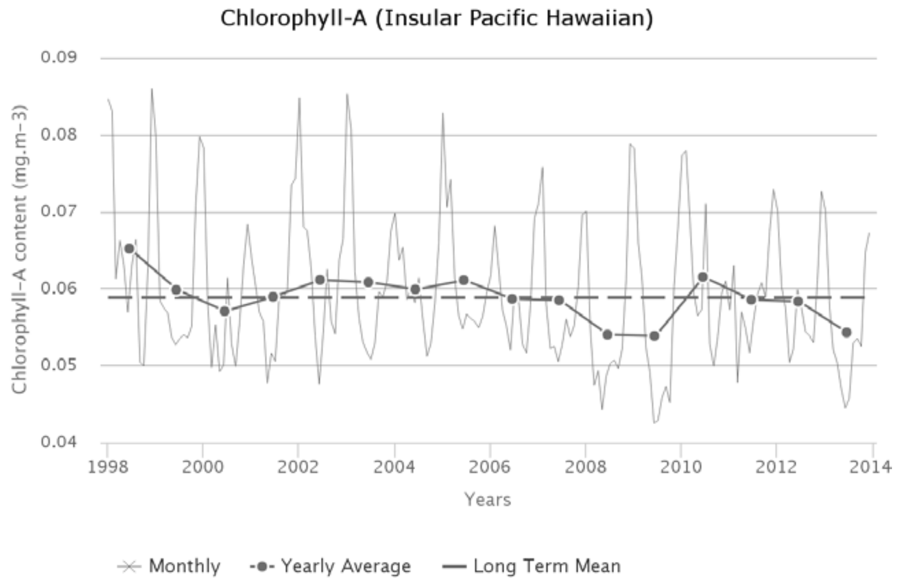
Based on a combined measure of the Human Development Index and the averaged indicators for fish & fisheries and pollution & ecosystem health modules, the overall risk factor is high.

Very low | Low | Medium | High | Very high

Productivity

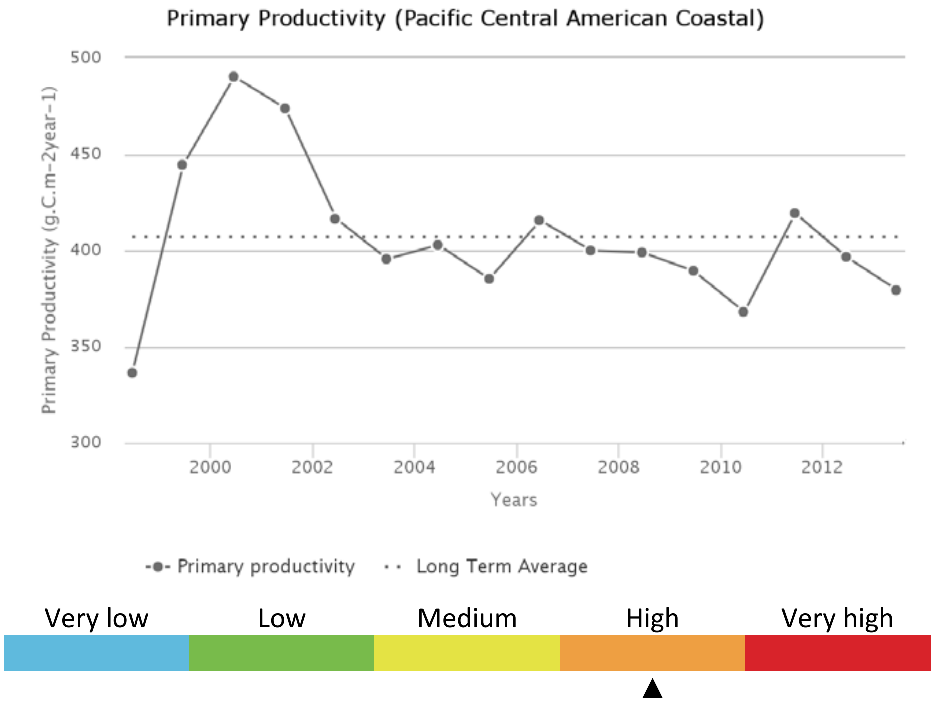
Chlorophyll-A

The annual Chlorophyll a concentration (CHL) cycle has a maximum peak (0.343 $mg.m^{-3}$) in March and a minimum (0.230 $mg.m^{-3}$) during August. The average CHL is 0.281 $mg.m^{-3}$. Maximum primary productivity (490 $g.C.m^{-2}.y^{-1}$) occurred during 2000 and minimum primary productivity (336 $g.C.m^{-2}.y^{-1}$) during 1998. There is a statistically insignificant increasing trend in Chlorophyll of 15.2 % from 2003 through 2013. The average primary productivity is 407 $g.C.m^{-2}.y^{-1}$, which places this LME in Group 4 of 5 categories (with 1 = lowest and 5= highest).



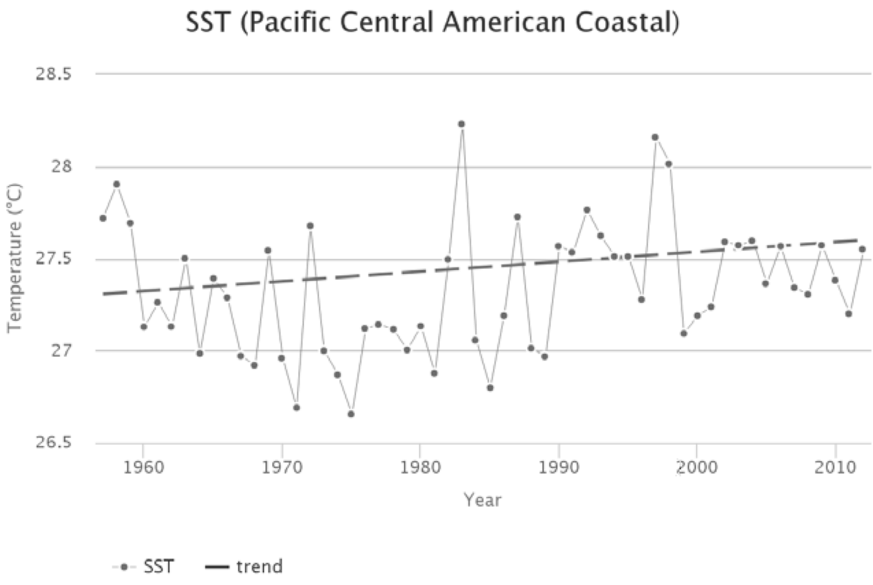
Very low | Low | Medium | High | Very high

Primary productivity



Sea Surface Temperature

Between 1957 and 2012, the Pacific Central-American Coastal LME #11 has warmed by 0.27C, thus belonging to Category 4 (slow warming LME). The thermal history of this LME was non-monotonous. The cooling phase culminated in two minima, in 1971 and 1975, both associated with major La Niñas (National Weather Service/Climate Prediction Center, 2007), after which SST rose by approximately 1°C over the next 30 years. The absolute minimum of 1975 was synchronous with absolute minima in two other East Pacific LMEs: California Current LME #3 and Gulf of California LME #4. It also was roughly synchronous with the absolute minimum of 1974-1976 on the other side of the Central American Isthmus, in the Caribbean LME #12. The warming phase was accentuated by two sharp peaks, in 1983 and 1997, both associated with major El Niños (National Weather Service/Climate Prediction Center, 2007). Similar warm events were observed in other East Pacific LMEs, namely the Humboldt Current LME #13, Gulf of California LME #4, and California Current LME #3. All significant maxima and minima of SST observed in the Pacific Central-American Coastal LME #11 are associated with El Niños and La Niñas respectively (National Weather Service/Climate Prediction Center, 2007).

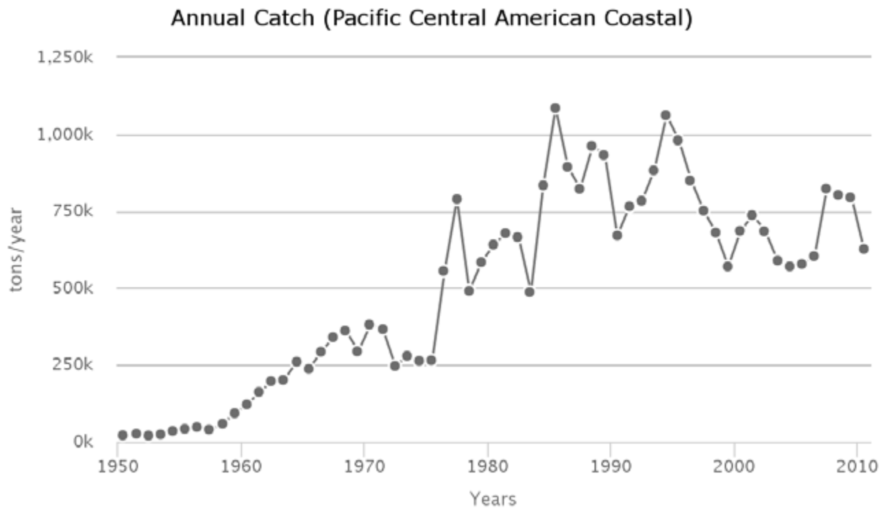


Fish and Fisheries

The Pacific Central-American Coastal LME is rich in both pelagic and demersal fisheries resources. The most valuable fisheries in the region are offshore tunas and coastal penaeid shrimps, whose landed fish bycatch is usually not reported. More than 50% of the reported shelf catches consists of small coastal pelagic species such as anchoveta (*Engraulis ringens* and *Cetengraulis mysticetus*), Pacific sardine (*Sardinops sagax*) and Pacific thread herring (*Opisthonema libertate*), most of which are used for fishmeal and fish-oil.

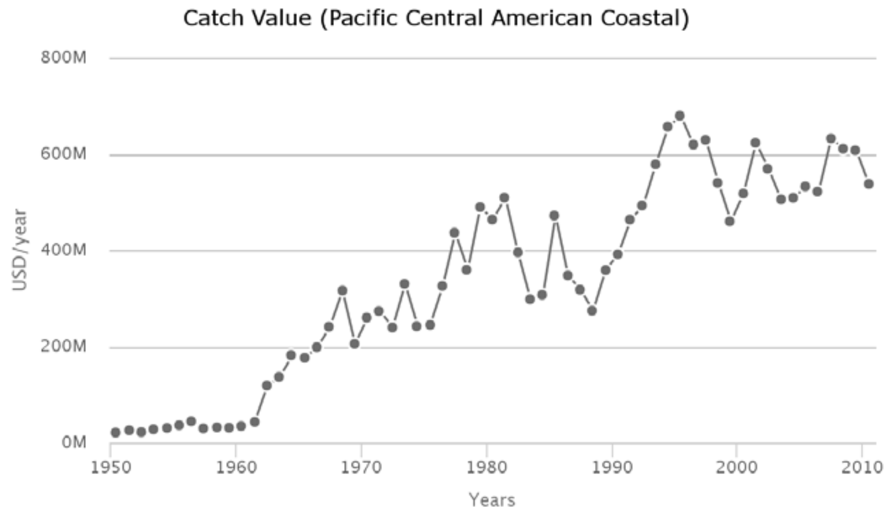
Annual Catch

Total reported landings have risen, with some fluctuations, to peak landings of 1 million t in 1985.



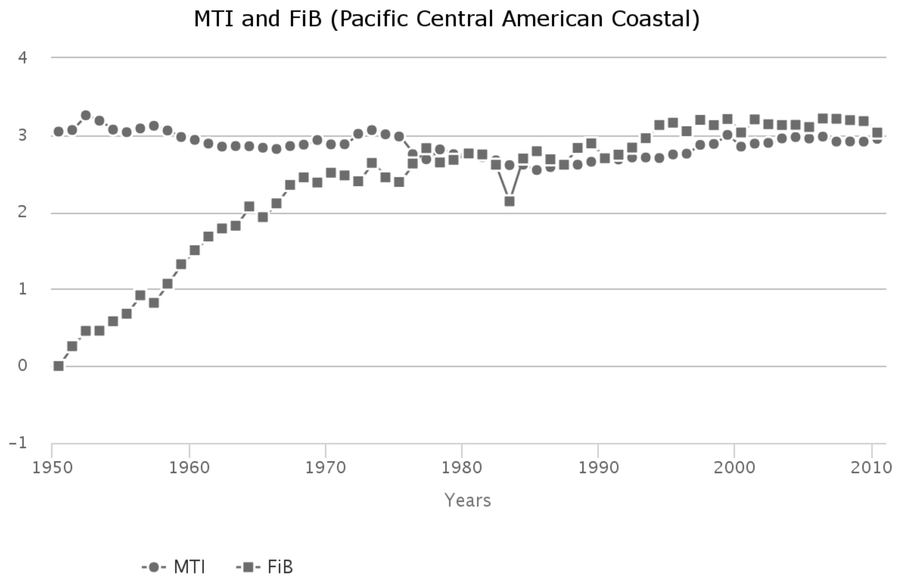
Catch value

Fluctuations in the value of the reported landings correspond with the landings, with a peak of 680 million US$ (in 2005 real US$) recorded in 1995.



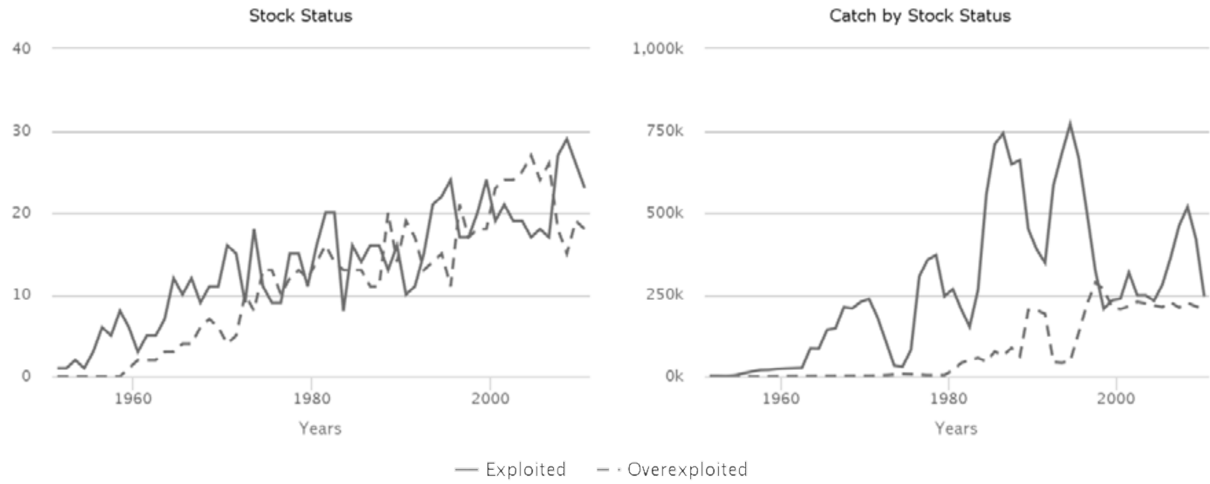
Marine Trophic Index and Fishing-in-Balance index

The MTI is relatively low, and shows a declining trend until the mid-1980s, after which a slight increasing trend became apparent. The FiB index has increased, indicating that whatever "fishing down" may be occurring in the LME would be masked by either the geographic (offshore) expansion of the fisheries or the incompleteness of the underlying catch statistics.



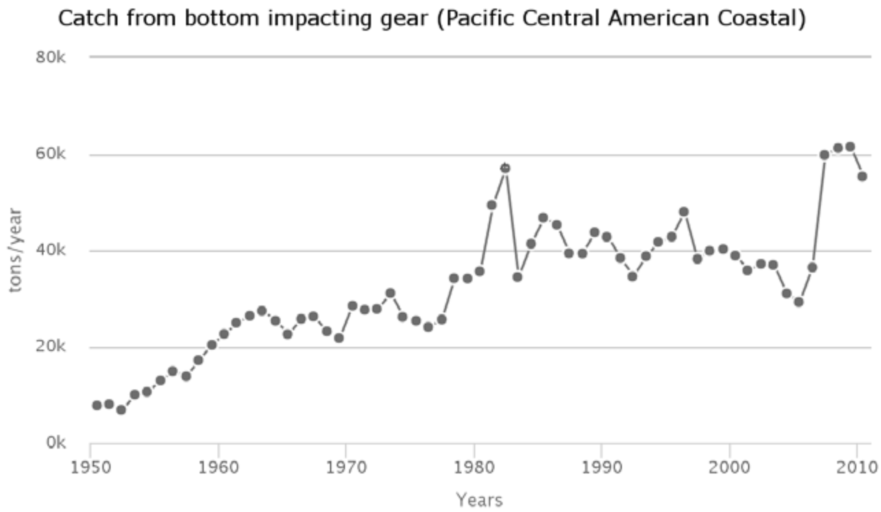
Stock status

The Stock-Catch Status Plots indicate that the number of collapsed and overexploited stocks are rapidly increasing in the LME. Approximately 40% of the reported landings are supplied by fully exploited stocks.



Catch from bottom impacting gear

The percentage of catch from the bottom gear type to the total catch reaches its maximum at 40% in 1953 and then this percentage declined steadily. This percentage ranged between 5 and 9% in the recent decade.



Fishing effort

The total effective effort increased steadily from around 30 million kW in the 1950s to its peak at 145 million kW in early 2000s.

Primary Production Required

The primary production required (PPR) to sustain the reported landings in this LME reached 5% of the observed primary production in 2002.

Pollution and Ecosystem Health

Pollution

Nutrient ratio, Nitrogen load and Merged Indicator

Human activities in watersheds are affecting nutrients transported by rivers into LMEs. Large amounts of nutrients (in particular *nitrogen load*) entering coastal waters of LMEs can result in high biomass algal blooms, leading to hypoxic or anoxic conditions, increased turbidity and changes in community composition, among other effects. In addition, changes in the *ratio of nutrients* entering LMEs can result in dominance by algal species that have deleterious effects (toxic, clog gills of shellfish, etc.) on ecosystems and humans. An overall nutrient indicator (*Merged Nutrient Indicator*) based on 2 sub-indicators: *Nitrogen Load* and *Nutrient Ratio* (ratio of dissolved Silica to Nitrogen or Phosphorus - the Index of Coastal Eutrophication Potential or ICEP) was calculated.

Nitrogen load

The Nitrogen Load risk level for contemporary (2000) conditions was moderate (level 3 of the five risk categories, where 1 = lowest risk; 5 = highest risk). Based on a "current trends" scenario (Global Orchestration), this remained the same in 2030 and 2050.

Nutrient ratio

The Nutrient Ratio (ICEP) risk level for contemporary (2000) conditions was very low (1). According to the Global Orchestration scenario, this remained the same in 2030 and 2050.

Merged nutrient indicator

The risk level for the Merged Nutrient Indicator for contemporary (2000) conditions was moderate (3). According to the Global Orchestration scenario, this remained the same in 2030 and 2050.

2000			2030			2050		
Nitrogen load	Nutrient ratio	Merged nutrient indicator	Nitrogen load	Nutrient ratio	Merged nutrient indicator	Nitrogen load	Nutrient ratio	Merged nutrient indicator
3	1	3	3	1	3	3	1	3

Legend: Very low, Low, Medium, High, Very high

POPs

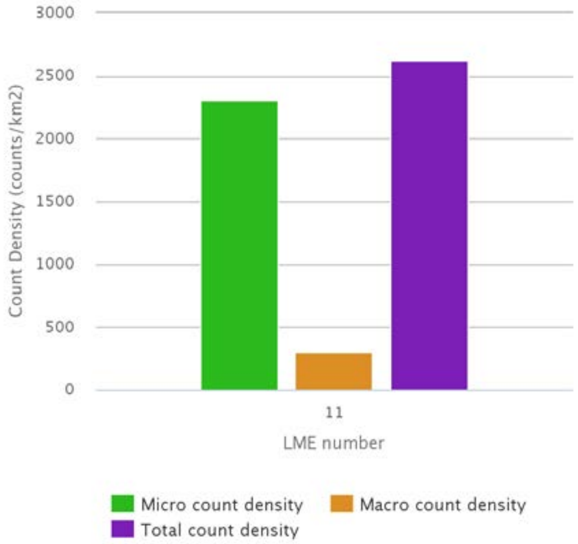
Data are available for only two samples at two locations in Costa Rica and Panama. These locations show low concentration for all the indicators. The average concentration (ng.g-1 of pellets) was 5 (range 2 – 7 ng.g-1) for PCBs, 5 (range 5 – 6 ng.g-1) for DDTs, and 0.1 (range 0.04 – 0.3 ng.g-1) for HCHs. The PCBs and HCHs averages correspond to risk category 1 and DDTs average corresponds to risk category 2, of the five risk categories (1 = lowest risk; 5 = highest risk). This is probably due to minimal anthropogenic activities involving the use of POPs (PCBs in industries and DDT and HCH pesticides in agriculture). More samples and locations are necessary to properly evaluate this LME.

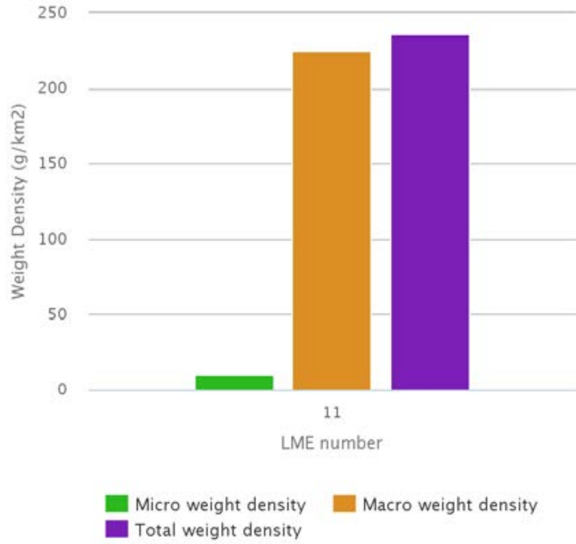
	PCBs		DDTs		HCHs	
Locations	Avg. (ng/g)	Risk	Avg. (ng/g)	Risk	Avg. (ng/g)	Risk
2	5	**1**	5	**2**	0.1	**1**

Legend: Very low, Low, Medium, High, Very high

Plastic debris

Modelled estimates of floating plastic abundance (items km^{-2}), for both micro-plastic (<4.75 mm) and macro-plastic (>4.75 mm), indicate that this LME is in the group with relatively moderate levels of plastic concentration. Estimates are based on three proxy sources of litter: shipping density, coastal population density and the level of urbanisation within major watersheds, with enhanced run-off. The high values are due to the relative importance of these sources in this LME. The abundance of floating plastic in this category is estimated to be on average over 12 times lower that those LMEs with lowest values. There is limited evidence from sea-based direct observations and towed nets to support this conclusion.





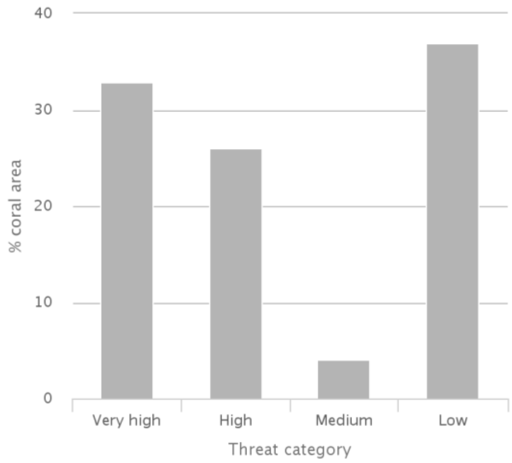
Ecosystem Health

Mangrove and coral cover

0.39% of this LME is covered by mangroves (US Geological Survey, 2011) and 0.03% by coral reefs (Global Distribution of Coral Reefs, 2010).

Reefs at risk

This LME has a present (2011) integrated threat index (combining threat from overfishing and destructive fishing, watershed-based and marine-based pollution and damage) of 235. 7% of coral reefs cover is under very high threat, and 26% under high threat (of the 5 possible threat categories, from low to critical). When combined with past thermal stress (between 1998 and 2007), these values increase to 20% and 60% for very high and high threat categories respectively. By year 2030, 39% of coral cover in this LME is predicted to be under very high to critical level of threat from warming and acidification; this proportion increases to 42% by 2050.

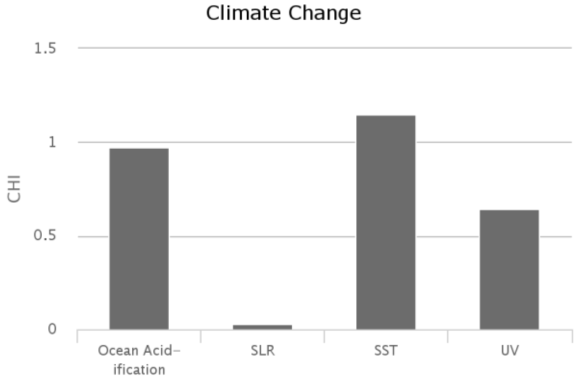


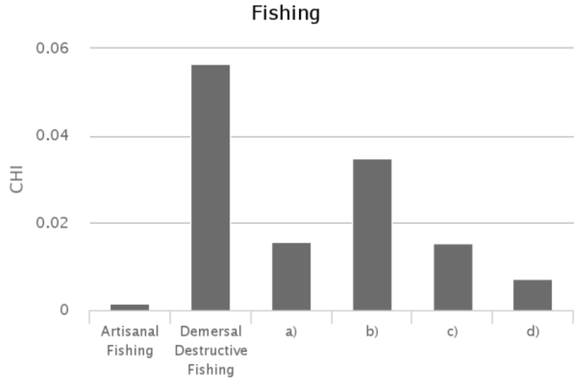
Marine Protected Area change

The Pacific Central-American Coastal LME experienced an increase in MPA coverage from 2,040 km^2 prior to 1983 to 29,444 km^{2}by 2014. This represents an increase of 1,343%, within the low category of MPA change.

Cumulative Human Impact

The Pacific Central-American Coastal LME experiences an average overall cumulative human impact (score 3.36; maximum LME score 5.22), but which is still well above the LME with the least cumulative impact. It falls in risk category 2 of the five risk categories (1 = lowest risk; 5 = highest risk). This LME is most vulnerable to climate change. Of the 19 individual stressors, three connected to climate change have the highest average impact on the LME: ocean acidification (0.97; maximum in other LMEs was 1.20), UV radiation (0.64; maximum in other LMEs was 0.76), and sea surface temperature (1.15; maximum in other LMEs was 2.16). Other key stressors include commercial shipping, ocean based pollution, and demersal destructive commercial fishing.





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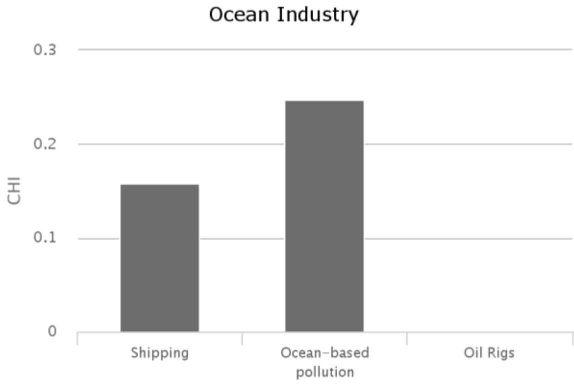
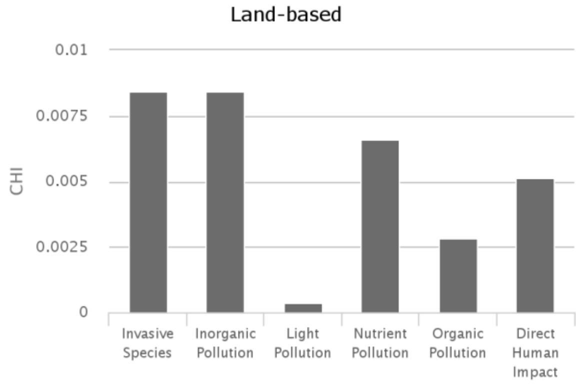
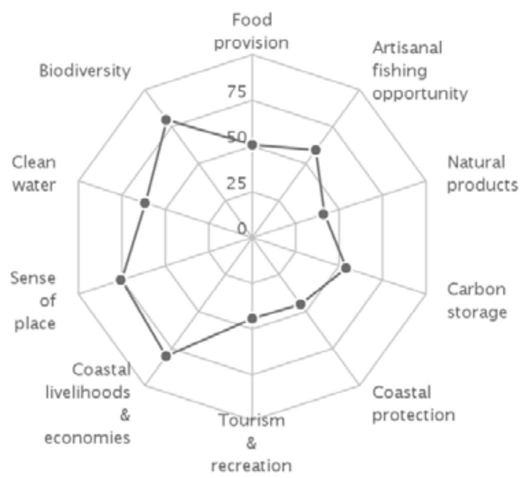




Ocean Health Index

The Pacific Central-American Coastal LME scores well below average on the Ocean Health Index compared to other LMEs (score 66 out of 100; range for other LMEs was 57 to 82). This score indicates that the LME is far from its optimal level of ocean health, although there are some aspects that are doing well. Its score in 2013 remained unchanged compared to the previous year. This LME scores lowest on food provision, coastal protection, carbon storage, tourism & recreation, and iconic species goals and highest on artisanal fishing opportunities, coastal economies, and lasting special places goals. It falls in risk category 5 of the five risk categories, which is the highest level of risk (1 = lowest risk; 5 = highest risk).

Ocean Health Index (Pacific Central American Coastal)



OHI: 59.14

Very low	Low	Medium	High	Very high
▲				

Socio-economics

Indicators of demographic trends, economic dependence on ecosystem services, human wellbeing and vulnerability to present-day extreme climate events and projected sea level rise, are assessed for the Pacific Central American Coastal LME. To compare and rank LMEs, they were classified into five categories of risk (from 1 to 5, corresponding to lowest, low, medium, high and highest risk, respectively) based on the values of the individual indicators. In the case of economic revenues, the LMEs were grouped to 5 classes of revenues from lowest, low, medium, high and highest, as revenues did not translate to risk.

Population

The littoral area includes the Pacific coasts of southern Mexico, Central America, and the South American nations of Colombia, Ecuador and northernmost portion of Peru, covering a total of 585,973 km^2. A current population of 50 million is projected to almost double to 98 million in 2100, as reflected in density increasing from 86 persons per km^2 in 2010 to 167 per km^2 by 2100. About 47% of coastal population lives in rural areas, and is projected to increase in share to 52% in 2100.

Total population		Rural population	
2010	**2100**	**2010**	**2100**
50,320,369	97,859,738	23,824,558	50,535,113

Legend: Very low, Low, Medium, High, Very high

Coastal poor

The indigent population makes up 44% of the LME's coastal dwellers. The Pacific Central American Coastal LME places in the very high-risk category based on percentage and absolute number of coastal poor (present day estimate).

Coastal poor
21,995,749

Revenues and Spatial Wealth Distribution

Fishing and tourism depend on ecosystem services provided by LMEs. The Pacific Central American Coastal LME ranks in the medium revenue category in fishing revenues based on yearly average total ex-vessel price of US 2013 $672 million for the period 2001-2010. Fish protein accounts for 7% of the total animal protein consumption of the coastal population. Its yearly average tourism revenue for 2004-2013 of US 2013 $48,482 million places it in the high revenue category. On average, LME-based tourism income contributes 12% to the national GDPs of the LME coastal states. Spatial distribution of economic activity (e.g. spatial wealth distribution) measured by night-light and population distribution as coarse proxies can range from 0.0000 (totally equal distribution and lowest risk) to 1.0000 (concentrated in 1 place and most inequitable and highest risk). The Night Light Development Index (NLDI) thus indicates the level of spatial economic development, and that for the Pacific Central American Coastal LME falls in the category with high risk.

Fisheries Annual Landed Value	% Fish Protein Contribution	Tourism Annual Revenues	% Tourism Contribution to GDP	NLDI
672,041,692	6.9	48,482,410,060	11.9	0.8253

Legend: Very low, Low, Medium, High, Very high

Human Development Index

Using the Human Development Index (HDI) that integrates measures of health, education and income, the present-day Pacific Central American Coastal LME HDI belongs to the low HDI and high-risk category. Based on an HDI of 0.693, this LME has an HDI Gap of 0.307, the difference between present and highest possible HDI (1.000). The HDI Gap measures an overall vulnerability to external events such as disease or extreme climate related events, due to less than perfect health, education, and income levels, and is independent of the harshness of and exposure to specific external shocks.

HDI values are projected to the year 2100 in the contexts of shared socioeconomic development pathways (SSPs). The Pacific Central American Coastal LME is projected to assume a place with the very low risk category (very high HDI) in 2100 under a sustainable development pathway or scenario. Under a fragmented world scenario, this LME is estimated to place in the very high-risk category (very low HDI) because of reduced income level and increased population size compared to estimated income and population values in a sustainable development pathway.

	HDI 2100	
HDI	SSP1	SSP3
0.6926	0.8934	0.5259

Legend: Very low, Low, Medium, High, Very high

Climate-Related Threat Indices

The Climate-Related Threat Indices utilize the HDI Gaps for present-day and projected 2100 scenarios. The contemporary climate index accounts for deaths and property losses due to storms, flooding and extreme temperatures incurred by coastal states during a 20-year period from 1994 to 2013 as hazard measures, the 2010 coastal population as proxy for exposure, and the present day HDI Gap as vulnerability measure.

The Contemporary Threat Index incorporates a Dependence Factor based on the fish protein contribution to dietary animal protein, and on the mean contribution of LME tourism to the national GDPs of LME coastal states. The HDI Gap and the degree of dependence on LME ecosystem services define the vulnerability of a coastal population. It also includes the average of risk related to extreme climate events, and the risk based on the degrading system states of an LME (e.g. overexploited fisheries, pollution levels, decrease in coastal ecosystem areas).

The 2100 sea level rise threat indices, each computed for the sustainable world and fragmented world development pathways, use the maximum projected sea level rise at the highest level of warming of 8.5 W/m^2 in 2100 as hazard measure, development pathway-specific 2100 populations in the 10 m × 10 km coast as exposure metrics, and development pathway-specific 2100 HDI Gaps as vulnerability estimates.

Present day climate threat index to the Pacific Central American Coastal LME is within the very high-risk (very high threat) category. The combined contemporaneous risk due to extreme climate events, degrading LME states and the level of vulnerability of the coastal population, is high. In a sustainable development scenario, the risk index from sea level rise in 2100 is lowest, and increases to very high risk under a fragmented world development pathway.

2010		2100	
Climate Threat	**Contemporary Threat**	**SSP1**	**SSP3**
0.8157	0.4398	0.3978	0.6583

Legend:

Very low Low Medium High Very high

Governance

Governance architecture

There are three separate transboundary arrangements for fisheries in general within the EEZ (CPPS, OLDESPECA and OSPESCA) as well as the arrangement for tuna and tuna-like species (IATTC). No integrating mechanisms, such as an overall policy coordinating organization for the LME, could be found. However, somewhat unique among LMEs, is the Secretariat for the Regional Seas Convention being housed at the Permanent Commission for the South Pacific (CPPS). While specific formal integration is not mentioned in the two Conventions, it is likely that the two Commissions have considerable informal linkages since the secretariats for both CPPS and the Lima Convention are within the same organization. Governance arrangements for this LME appear to be split along geographic lines with arrangements for the southern part of the LME being distinct from those for the northern part.

The overall scores for the ranking of risk were:

Engagement	Completeness	Integration
53	**65**	**0.1**

Legend:

Very low Low Medium High Very high

LME 12 – Caribbean Sea

Bordering countries: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Cayman Islands, Colombia, Commonwealth of Dominica, Costa Rica, Cuba, Dominican Republic, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, France (Martinique), Mexico, Montserrat, Netherland Antilles, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, United States Virgin Islands, Venezuela
LME Total area: 3,305,077 km^2
This LME is GEF eligible

List of indicators

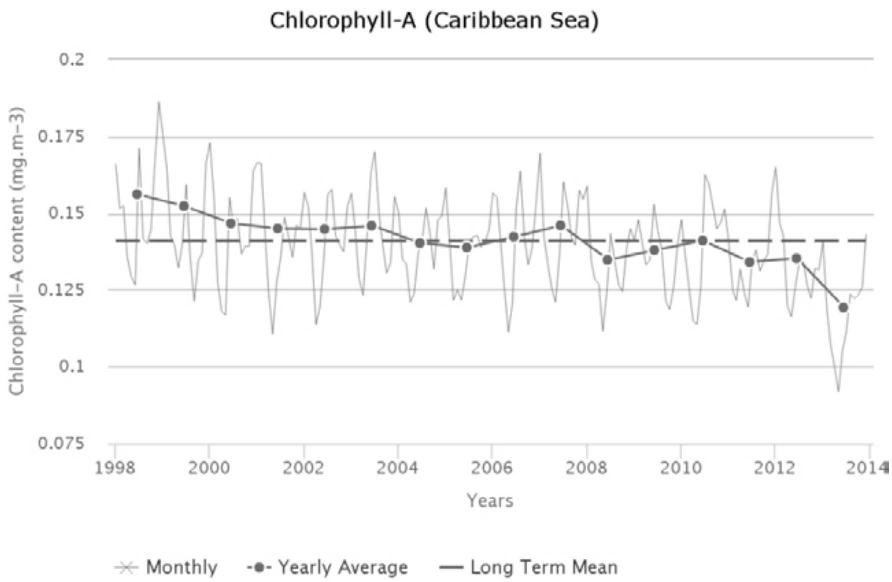
LME overall risk

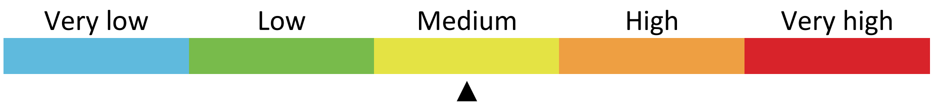
This LME falls in the cluster of LMEs that exhibit low to medium levels of economic development (based on the night light development index) and medium levels of collapsed and overexploited fish stocks.
Based on a combined measure of the Human Development Index and the averaged indicators for fish & fisheries and pollution & ecosystem health modules, the overall risk factor is high.

Productivity

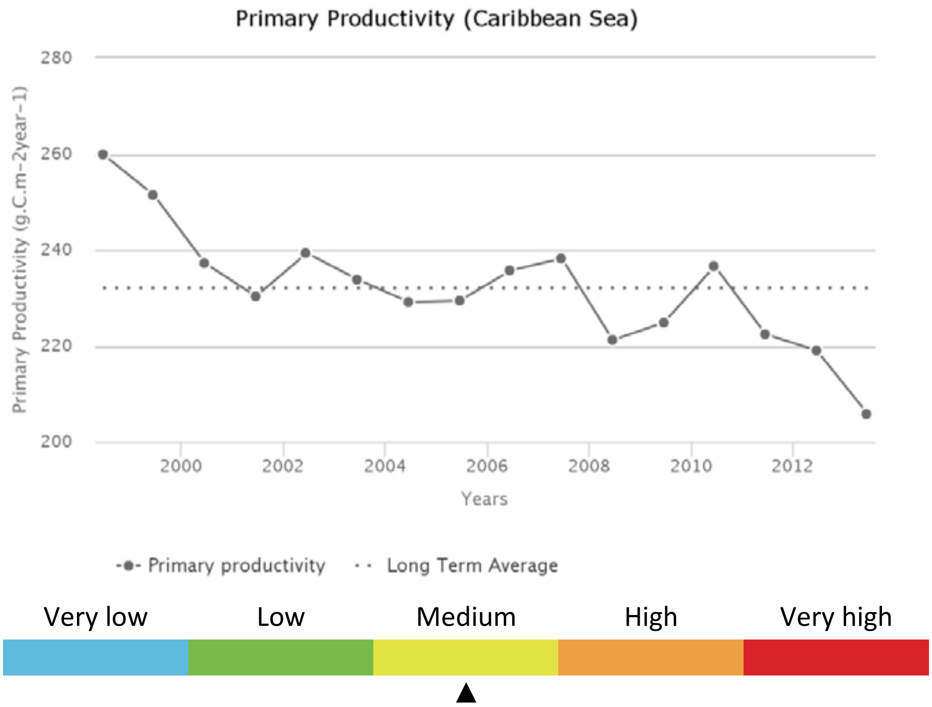
Chlorophyll-A

The annual Chlorophyll a concentration (CHL) cycle has a maximum peak (0.159 $mg.m^{-3}$) in January and a minimum (0.121 $mg.m^{-3}$) during May. The average CHL is 0.141 $mg.m^{-3}$. Maximum primary productivity (260 $g.C.m^{-2}.y^{-1}$) occurred during 1998 and minimum primary productivity (206 $g.C.m^{-2}.y^{-1}$) during 2013. There is a statistically insignificant increasing trend in Chlorophyll of 5.29 % from 2003 through 2013. The average primary productivity is 232 $g.C.m^{-2}.y^{-1}$, which places this LME in Group 3 of 5 categories (with 1 = lowest and 5= highest).



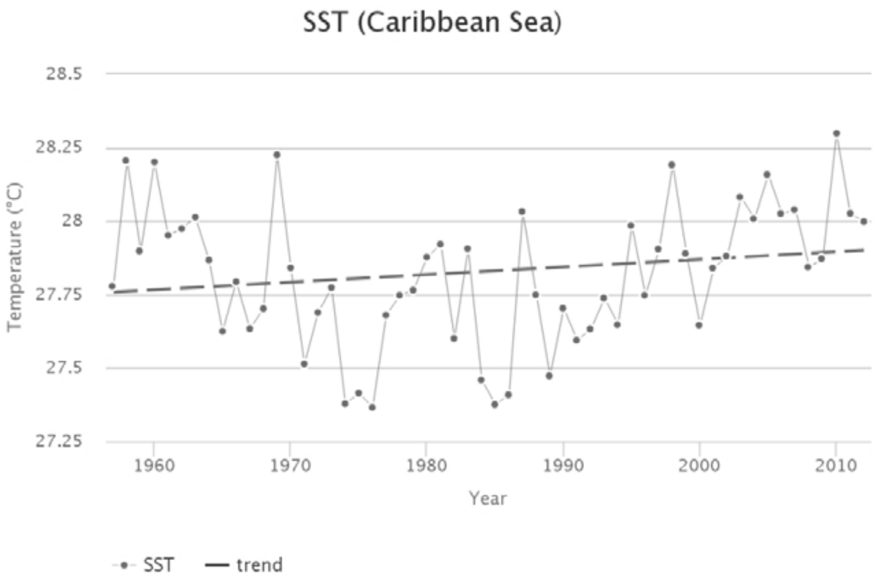


Primary productivity



Sea Surface Temperature

Between 1957 and 2012, the Caribbean Sea LME #12 has warmed by 0.15°C, thus belonging to Category 4 (slow warming LME). This LME went through three phases over the last 50 years: (1) cooling until 1974; (2) a cold phase with two cold spells, in 1974-1976 and 1984-1986; (3) warming since 1986. Using the year of 1985 as a true breakpoint, the post-1985 warming exceeded 0.9°C, from <27.4°C in 1985 to 28.3°C in 2010. Both cold spells were synchronous with cold events across the Central American Isthmus, in the Pacific Central-American Coastal LME #11. The first cooling period was interrupted by a major warm event (peak) of 1968-1970, when SST peaked at 28.2°C in 1969. This event was confined to the Caribbean Sea. None of adjacent LMEs experienced a pronounced warming in 1968-1970. All significant maxima and minima of SST in the Caribbean Sea correlate strongly with El Niños and La Niñas respectively (National Weather Service/Climate Prediction Center, 2007). This strong correlation is a good example of atmospheric teleconnections across the Central American Isthmus. This link is so strong that El Niños' and La Niñas' effects in the Caribbean Sea have comparable magnitudes with their counterparts in the Pacific Central-American Coastal LME #11 on the other side of the Isthmus.

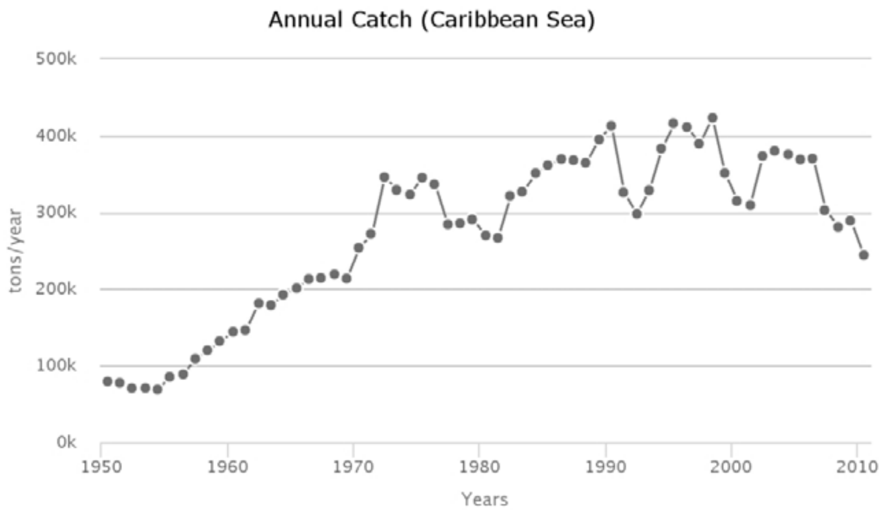


Fish and Fisheries

The fisheries of the Caribbean Sea LME are based on a diverse array of resources, and those of greatest importance are spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*), penaeid shrimps, reef fish, continental shelf demersal fish, deep slope and bank fish and large coastal pelagics such as king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculatus*), dolphinfish (*Coryphaena hippurus*) and amberjack (*Seriola spp.*). In addition, fisheries based on stocks of large oceanic fish such as yellowfin tuna, skipjack tuna, Atlantic blue marlin and swordfish, have expanded considerably.

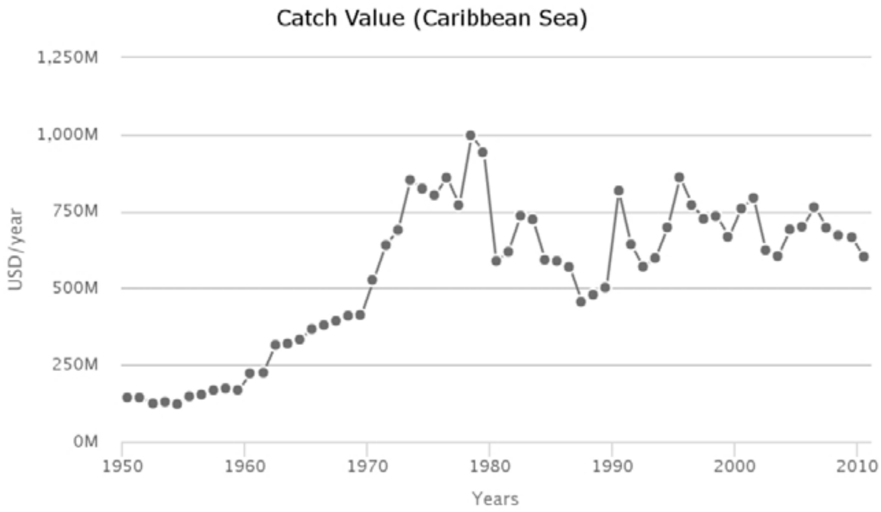
Annual Catch

Total reported landings in this LME, which is probably underestimated showed a general increase to about 430,000 t in the 1998, followed by a slight decline.



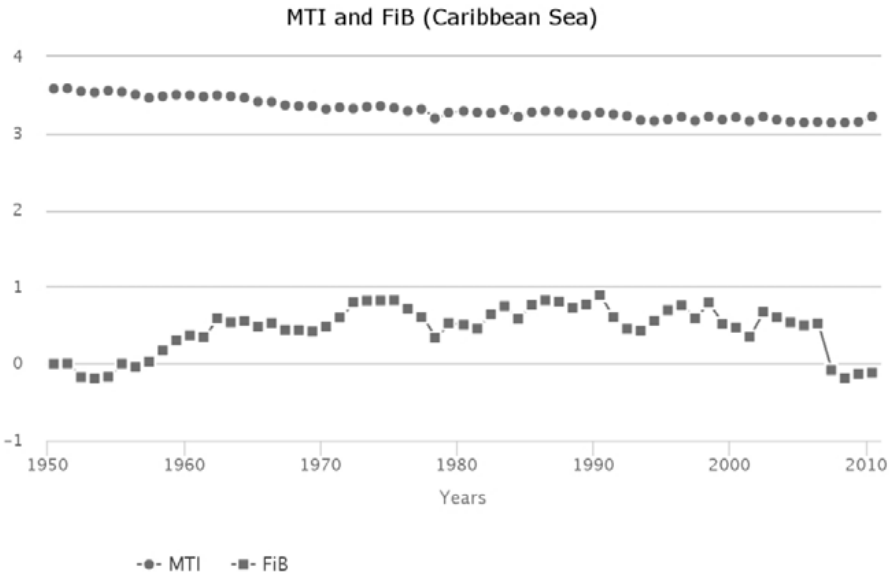
Catch value

The reported landings peaked at just under 1 billion US$ (in 2005 value) in 1978.



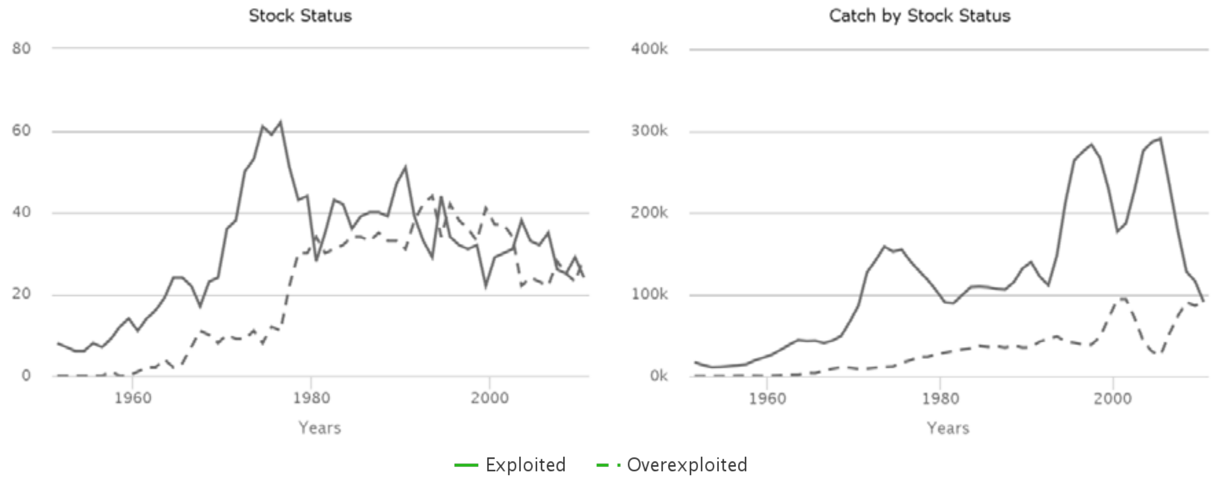
Marine Trophic Index and Fishing-in-Balance index

The decline of the MTI is almost linear over the reported period, representing a classic case of 'fishing down' of the food web in the LME. Indeed, the decline in the mean trophic level would have been greater than the expansion of the fisheries from the mid-1950 to the mid-1980s as implied by the increasing FiB index.



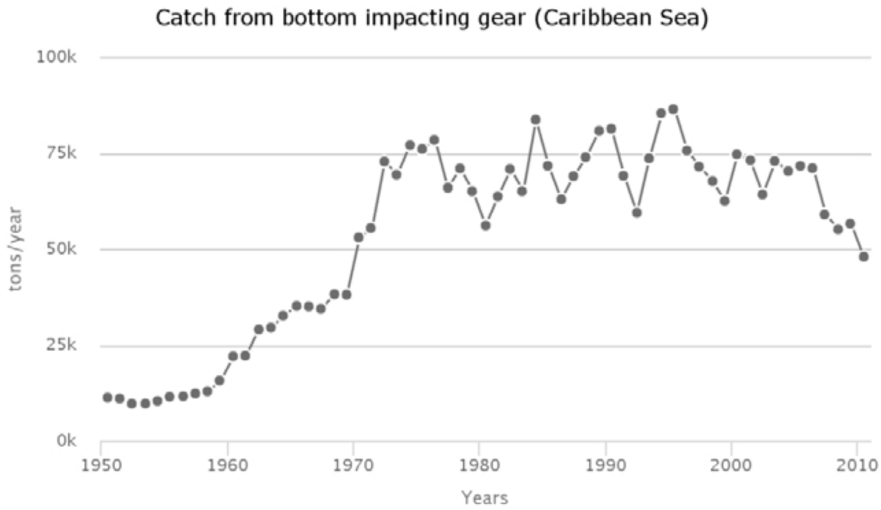
Stock status

The Stock-Catch Status Plots indicate that nearly 60% of the commercially exploited stocks in the LME are either overexploited or have collapsed and these stocks now contribute 50% of the reported landings.



Catch from bottom impacting gear

The percentage of catch from the bottom gear type to the total catch increased slightly from 11% in late 1950s to the peak at 25% in 1978. Then, this percentage fluctuated around 20% in the recent few decades.

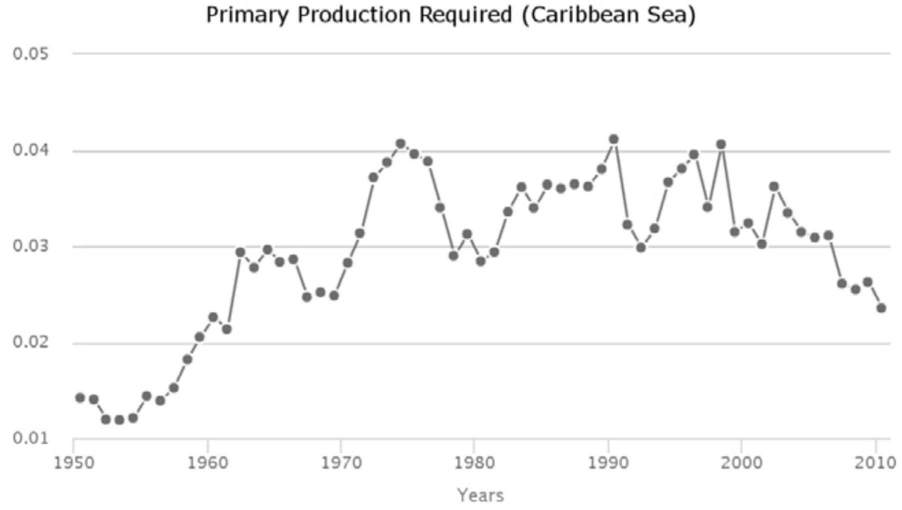


Fishing effort

The total effective effort continuously increased from around 40 million kW in the 1950s to its peak at 240 million kW in the mid- 2000s.

Primary Production Required

The primary production required (PPR) to sustain the reported landings in the LME reached 3% of the observed primary production in 1994, and fluctuated between 2.5 to 3% in recent years.



Pollution and Ecosystem Health

Pollution

Nutrient ratio, Nitrogen load and Merged Indicator

Human activities in watersheds are affecting nutrients transported by rivers into LMEs. Large amounts of nutrients (in particular nitrogen load) entering coastal waters of LMEs can result in high biomass algal blooms, leading to hypoxic or anoxic conditions, increased turbidity and changes in community composition, among other effects. In addition, changes in the ratio of nutrients entering LMEs can result in dominance by algal species that have deleterious effects (toxic, clog gills of shellfish, etc.) on ecosystems and humans. An overall nutrient indicator (Merged Nutrient Indicator) based on 2 sub-indicators: Nitrogen Load and Nutrient Ratio (ratio of dissolved Silica to Nitrogen or Phosphorus - the Index of Coastal Eutrophication Potential or ICEP) was calculated.

Nitrogen load

The Nitrogen Load risk level for contemporary (2000) conditions was moderate (level 3 of the five risk categories, where 1 = lowest risk; 5 = highest risk). Based on a “current trends” scenario (Global Orchestration), this increased to high in 2030 and remained high in 2050.

Nutrient ratio

The Nutrient Ratio (ICEP) risk level for contemporary (2000) conditions was very low (1). According to the Global Orchestration scenario, this remained the same in 2030 and 2050.

Merged nutrient indicator

The risk level for the Merged Nutrient Indicator for contemporary (2000) conditions was moderate (3). According to the Global Orchestration scenario, this increased to high in 2030 and remained the same in 2050

2000			2030			2050		
Nitrogen load	Nutrient ratio	Merged nutrient indicator	Nitrogen load	Nutrient ratio	Merged nutrient indicator	Nitrogen load	Nutrient ratio	Merged nutrient indicator
3	1	3	4	1	4	4	1	4

Legend: Very low, Low, Medium, High, Very high

POPs

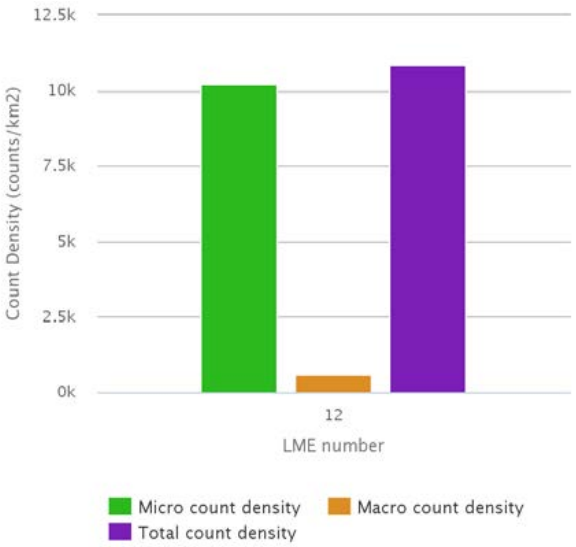
Data are available only for two samples at two locations in Barbados and Trinidad & Tobago. These locations show minimal concentration for all the indicators. The average concentration (ng.g^{-1} of pellets) was 4 (range 2 – 6 ng.g^{-1}) for PCBs, 3 (range 2 – 3 ng.g^{-1}) for DDTs, and 0.9 (range 0.8 – 1.1 ng.g^{-1}) for HCHs. All three averages correspond to risk category 1 of the five risk categories (1 = lowest risk; 5 = highest risk). This is probably due to minimal anthropogenic activities involving the use of POPs (PCBs in industries and DDT and HCH pesticides in agriculture).

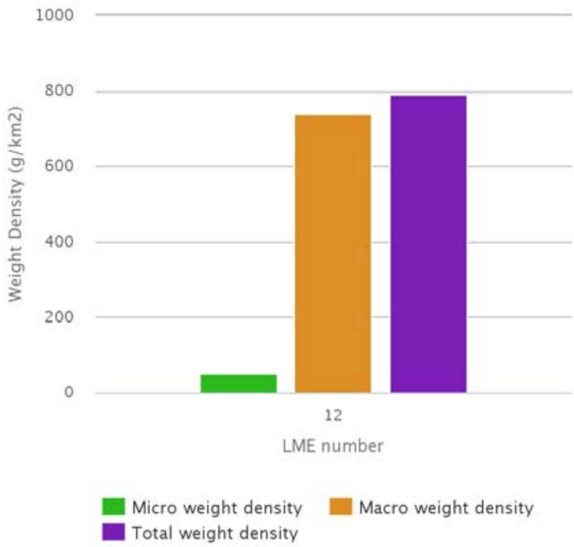
	PCBs		DDTs		HCHs	
Locations	Avg. (ng/g)	Risk	Avg. (ng/g)	Risk	Avg. (ng/g)	Risk
2	4	**1**	3	**1**	0.9	**1**

Legend: Very low, Low, Medium, High, Very high

Plastic debris

Modelled estimates of floating plastic abundance (items km^{-2}), for both micro-plastic (<4.75 mm) and macro-plastic (>4.75 mm), indicate that this LME is in the group with relatively high levels of plastic concentration. Estimates are based on three proxy sources of litter: shipping density, coastal population density and the level of urbanisation within major watersheds, with enhanced run-off. The high values are due to the relative importance of these sources in this LME. The abundance of floating plastic in this category there is good evidence from sea-based direct observations and towed nets to support this conclusion.





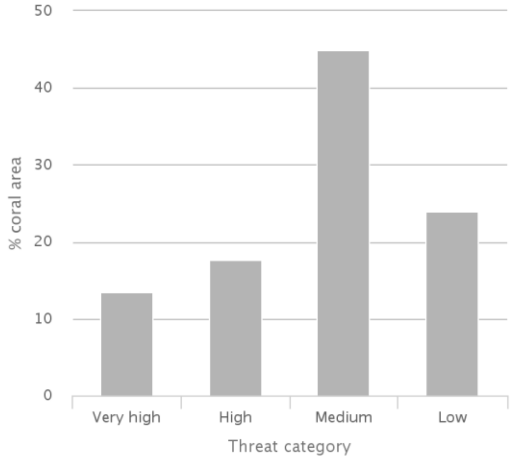
Ecosystem Health

Mangrove and coral cover

0.35% of this LME is covered by mangroves (US Geological Survey, 2011) and 0.64% by coral reefs (Global Distribution of Coral Reefs, 2010).

Reefs at risk

This LME has a present (2011) integrated threat index (combining threat from overfishing and destructive fishing, watershed-based and marine-based pollution and damage) of 221. 13% of coral reefs cover is under very high threat, and 18% under high threat (of the 5 possible threat categories, from low to critical). When combined with past thermal stress (between 1998 and 2007), these values increase to 23% and 32% for very high and high threat categories respectively. By year 2030, 29% of coral cover in this LME is predicted to be under very high to critical level of threat from warming and acidification; this proportion increases to 40% by 2050.

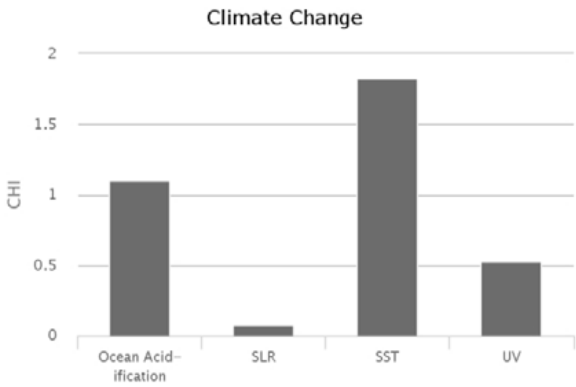


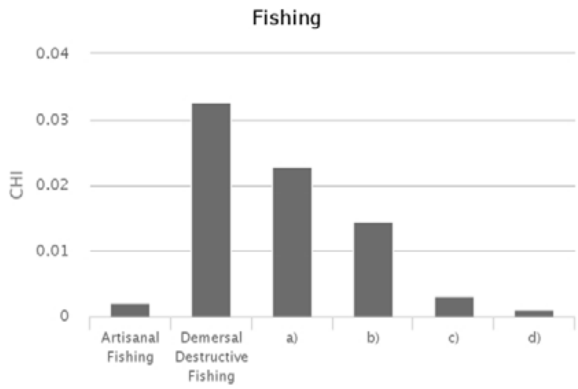
Marine Protected Area change

The Caribbean Sea LME experienced an increase in MPA coverage from 6,463 km^2 prior to 1983 to 143,096 km^2 by 2014. This represents an increase of 2,114%, within the medium category of MPA change.

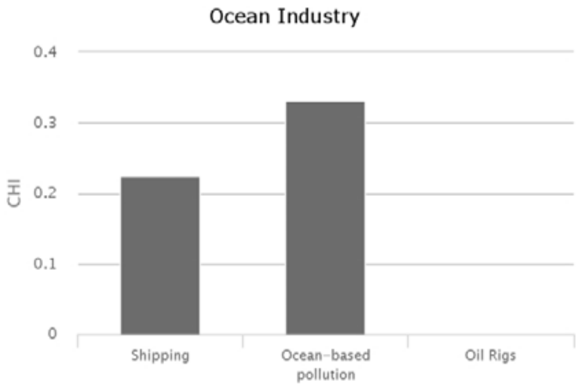
Cumulative Human Impact

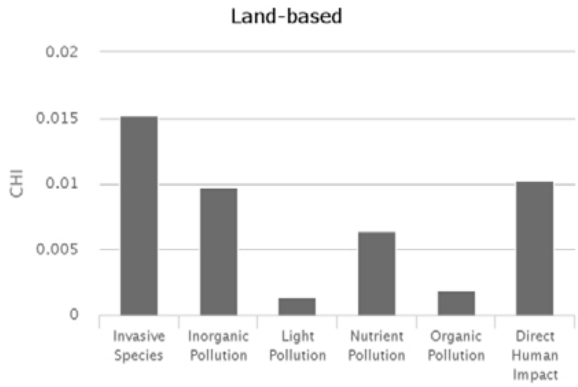
The Caribbean Sea LME experiences an above average overall cumulative human impact (score 4.21; maximum LME score 5.22), which is well above the LME with the least cumulative impact. It falls in risk category 4 of the five risk categories (1 = lowest risk; 5 = highest risk). This LME is most vulnerable to climate change. Of the 19 individual stressors, three connected to climate change have the highest average impact on the LME: ocean acidification (1.11; maximum in other LMEs was 1.20), UV radiation (0.52; maximum in other LMEs was 0.76), and sea surface temperature (1.82; maximum in other LMEs was 2.16). Other key stressors include commercial shipping and ocean based pollution.

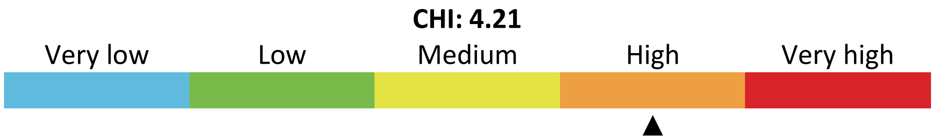




a) Demersal Non-destructive High Bycatch Fishing
c) Pelagic High Bycatch Fishing
b) Demersal Non-destructive Low Bycatch Fishing
d) Pelagic Low Bycatch Fishing

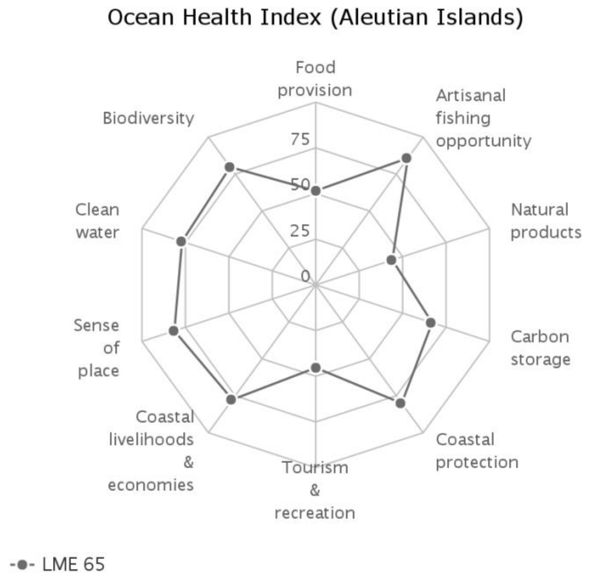


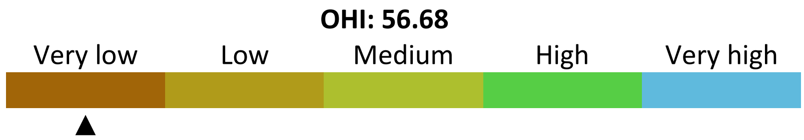




Ocean Health Index

The Caribbean Sea LME scores well below average on the Ocean Health Index compared to other LMEs (score 60 out of 100; range for other LMEs was 57 to 82). This score indicates that the LME is far from its optimal level of ocean health, although there are some aspects that are doing well. Its score in 2013 remained unchanged compared to the previous year. This LME scores lowest on food provision, natural products, coastal protection and tourism & recreation goals and highest on artisanal fishing opportunities and coastal economies goals. It falls in risk category 5 of the five risk categories, which is the highest level of risk (1 = lowest risk; 5 = highest risk).





Socio-economics

Indicators of demographic trends, economic dependence on ecosystem services, human wellbeing and vulnerability to present-day extreme climate events and projected sea level rise, are assessed for the Caribbean Sea LME. To compare and rank LMEs, they were classified into five categories of risk (from 1 to 5, corresponding to lowest, low, medium, high and highest risk, respectively) based on the values of the individual indicators. In the case of economic revenues, the LMEs were grouped to 5 classes of revenues from lowest, low, medium, high and highest, as revenues did not translate to risk.

Population

The littoral area includes the eastern coast of the Yucatan Peninsula, the Atlantic coast of Central America, Colombia and Venezuela, and 24 Caribbean island states covering a total of 794,777 km^2. A current population of 84 million is projected to reach to 127 million in 2100, and density increasing from 106 persons per km^2 in 2010 to 159 per km^2 by 2100. About 42% of coastal population lives in rural areas, and is projected to increase in share to 46% in 2100.

Total population		Rural population	
2010	2100	2010	2100
84,263,359	126,576,916	35,485,511	58,003,582

Legend: Very low, Low, Medium, High, Very high

Coastal poor

The indigent population makes up 32% of the LME's coastal dwellers. The Caribbean Sea LME places in the very high-risk category based on percentage and absolute number of coastal poor (present day estimate).

Coastal poor
26,619,339

Revenues and Spatial Wealth Distribution

Fishing and tourism depend on ecosystem services provided by LMEs. The Caribbean Sea LME ranks in the high revenue category in fishing revenues based on yearly average total ex-vessel price of US 2013 $810 million for the period 2001-2010. Fish protein accounts for 9% of the total animal protein consumption of the coastal population. Its yearly average tourism revenue for 2004-2013 of US 2013 $90,454 million places it in the very high revenue category. On average, LME-based tourism income contributes 18% to the national GDPs of the LME coastal states. Spatial distribution of economic activity (e.g. spatial wealth distribution) measured by night-light and population distribution as coarse proxies can range from 0.0000 (totally equal distribution and lowest risk) to 1.0000 (concentrated in 1 place and most inequitable and highest risk). The Night Light Development Index (NLDI) thus indicates the level of spatial economic development, and that for the Caribbean Sea LME falls in the category with medium risk.

Fisheries Annual Landed Value	% Fish Protein Contribution	Tourism Annual Revenues	% Tourism Contribution to GDP	NLDI
810,509,428	8.7	90,454,384,76018.0	18.0	0.7499

Legend:

Very low Low Medium High Very high

Human Development Index

Using the Human Development Index (HDI) that integrates measures of health, education and income, the present-day Caribbean Sea LME HDI belongs to the medium HDI and high-risk category. Based on an HDI of 0.718, this LME has an HDI Gap of 0.282, the difference between present and highest possible HDI (1.000). The HDI Gap measures an overall vulnerability to external events such as disease or extreme climate related events, due to less than perfect health, education, and income levels, and is independent of the harshness of and exposure to specific external shocks.

HDI values are projected to the year 2100 in the contexts of shared socioeconomic development pathways (SSPs). The Caribbean Sea LME is projected to assume a place with the very low risk category (very high HDI) in 2100 under a sustainable development pathway or scenario. Under a fragmented world scenario, this LME is estimated to place in the very high-risk category (very low HDI) because of reduced income level and increased population size compared to estimated income and population values in a sustainable development pathway.

	HDI 2100	
HDI	SSP1	SSP3
0.7185	0.8970	0.5611

Legend:

Very low Low Medium High Very high

Climate-Related Threat Indices

The Climate-Related Threat Indices utilize the HDI Gaps for present-day and projected 2100 scenarios. The contemporary climate index accounts for deaths and property losses due to storms, flooding and extreme temperatures incurred by coastal states during a 20-year period from 1994 to

2013 as hazard measures, the 2010 coastal population as proxy for exposure, and the present day HDI Gap as vulnerability measure.

The Contemporary Threat Index incorporates a Dependence Factor based on the fish protein contribution to dietary animal protein, and on the mean contribution of LME tourism to the national GDPs of LME coastal states. The HDI Gap and the degree of dependence on LME ecosystem services define the vulnerability of a coastal population. It also includes the average of risk related to extreme climate events, and the risk based on the degrading system states of an LME (*e.g.* overexploited fisheries, pollution levels, decrease in coastal ecosystem areas).

The 2100 sea level rise threat indices, each computed for the sustainable world and fragmented world development pathways, use the maximum projected sea level rise at the highest level of warming of 8.5 W/m^2 in 2100 as hazard measure, development pathway-specific 2100 populations in the 10 m × 10 km coast as exposure metrics, and development pathway-specific 2100 HDI Gaps as vulnerability estimates.

Present day climate threat index to the Caribbean Sea LME is within the very high-risk (very high threat) category. The combined contemporaneous risk due to extreme climate events, degrading LME states and the level of vulnerability of the coastal population, is very high. In a sustainable development scenario, the risk index from sea level rise in 2100 is lowest, and increases to high risk under a fragmented world development pathway.

2010		**2100**	
Climate Threat	**Contemporary Threat**	**SSP1**	**SSP3**
0.8389	0.4807	0.3944	0.6425

Legend: Very low | Low | Medium | High | Very high

Governance

Governance architecture

Three arrangements for transboundary fisheries in this LME - CRFM, OSPESCA and WECAFC - are connected. OLDEPESCA is minimally connected within the LME. None of the fisheries arrangements are connected with ICCAT. The arrangements for pollution and biodiversity that fall under the Cartagena Convention are connected via the CEP, but do not appear well connected with fisheries or with the IAC. No integrating mechanisms, such as an overall policy coordinating organization for the LME, could be found. There may be interaction amongst the arrangements through participation in each other's meetings, but this appears to be informal.

The overall scores for the ranking of risk were:

Engagement	Completeness	Integration
53	**60**	**0.2**

Legend: Very low | Low | Medium | High | Very high


Caribbean Sea Large Marine Ecosystem
Pacific Central American Shelf
Large Marine Ecosystem

NASA Shuttle Radar Topography Mission

UNEP-DHI PARTNERSHIP
Centre on Water and Environment
UNEP
DHI
United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme
United Nations Educational, Scientific and Cultural Organization · Intergovernmental Oceanographic Commission
ILEC
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MINISTRY FOR FOREIGN AFFAIRS OF FINLAND

The water systems of the world – aquifers, lakes, rivers, large marine ecosystems, and open ocean- sustain the biosphere and underpin the socioeconomic wellbeing of the world's population. Many of these systems are shared by two or more nations. These transboundary waters, stretching over 71% of the planet's surface, in addition to the subsurface aquifers, comprise humanity's water heritage.

Recognizing the value of transboundary water systems and the reality that many of them continue to be degraded and managed in fragmented ways, the Global Environment Facility Transboundary Waters Assessment Programme (GEF TWAP) was developed. The Programme aims to provide a baseline assessment to identify and evaluate changes in these water systems caused by human activities and natural processes, and the consequences these may have on dependent human populations. The institutional partnerships forged in this assessment are envisioned to seed future transboundary assessments as well.

The final results of the GEF TWAP are presented in the following six volumes:
Volume 1 – ***Transboundary Aquifers and Groundwater Systems of Small Island Developing States: Status and Trends***
Volume 2 – ***Transboundary Lakes and Reservoirs: Status and Trends***
Volume 3 – ***Transboundary River Basins: Status and Trends***
Volume 4 – ***Large Marine Ecosystems: Status and Trends***
Volume 5 – ***The Open Ocean: Status and Trends***
Volume 6 – ***Transboundary Water Systems: Crosscutting Status and Trends***

A *Summary* for Policy Makers accompanies each volume. All TWAP publications are available for download at http://www.geftwap.org

This annex – Transboundary waters: A Global Compendium, Water System Information Sheets: Central America & Caribbean, Volume 6-Annex B -- is one of 12 annexes to the Crosscutting Analysis discussed in Volume 6. The global compendium organized into 14 TWAP regions, compiles information sheets on 765 international water systems including the baseline values of quantitative indicators that were used to establish contemporary and relative risk levels at system and regional scales. Over the long term, it is envisioned that these baseline information sheets will continue to be updated by future assessments at multiple spatial and temporal scales to better track the changing states of transboundary waters that are essential in sustaining human wellbeing and ecosystem health.

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United Nations Environment Programme
P.O. Box 30552 - 00100 Nairobi, Kenya
Tel.: +254 20 762 1234
Fax: +254 20 762 3927
e-mail: publications@unep.org
www.unep.org

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