



NILE BASIN INITIATIVE
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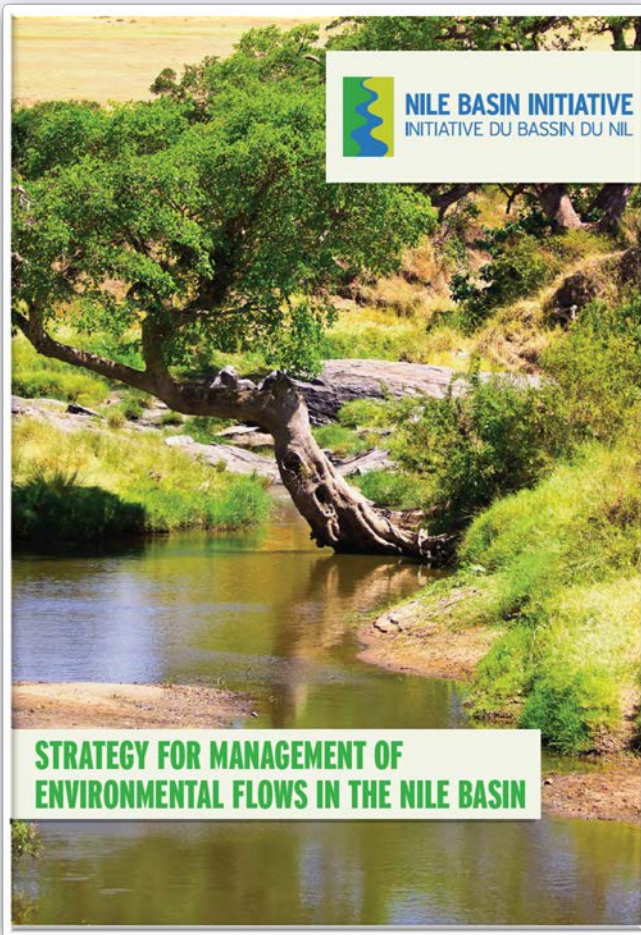


SUDD

E-FLOW STUDY

BY G O'BRIEN, M WADE & A HUSTED

Environmental flows in the Sudd



DEFINITION: ENVIRONMENTAL FLOWS

ENVIRONMENTAL FLOWS DESCRIBE THE QUANTITY, TIMING, AND QUALITY OF FRESHWATER FLOWS AND LEVELS NECESSARY TO SUSTAIN AQUATIC ECOSYSTEMS WHICH, IN TURN, SUPPORT HUMAN CULTURES, ECONOMIES, LIVELIHOODS, AND WELL-BEING.

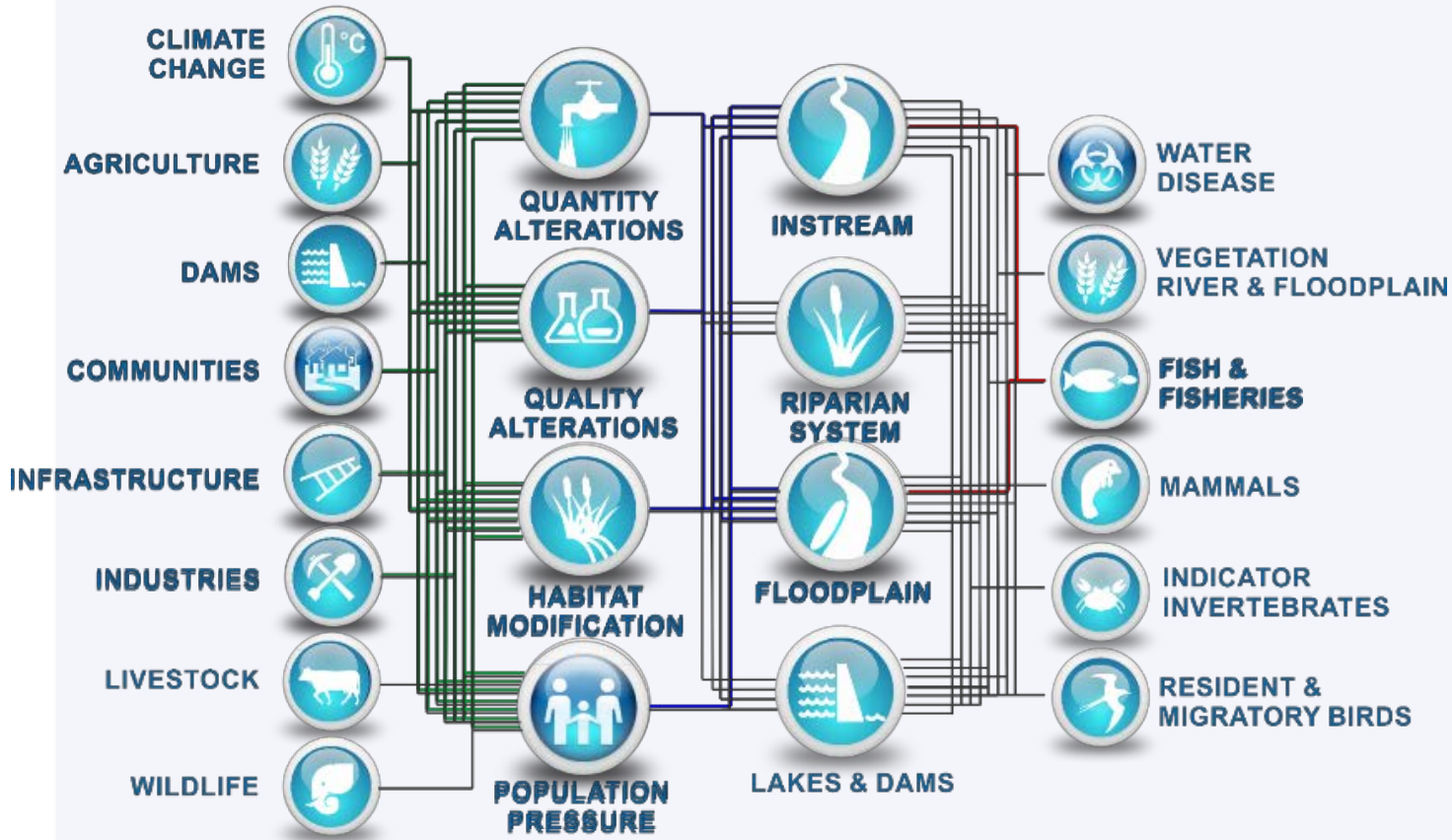
BRISBANE DECLARATION OF ENVIRONMENTAL FLOWS
(BRISBANE, 2018)

Aquatic ecosystems include rivers, streams, springs, floodplain and other wetlands, lakes, coastal waterbodies, including lagoons and estuaries, and groundwater-dependent ecosystems.

Although we'll stick with the term "Environmental Flows (E-Flows)" some people refer to Instream Flow Requirements (IFR), Environmental Water Requirements (EWR), and Environmental Water etc.

Environmental flows in the Sudd

USE ACTIVITIES STRESSORS HABITATS ENDPOINTS

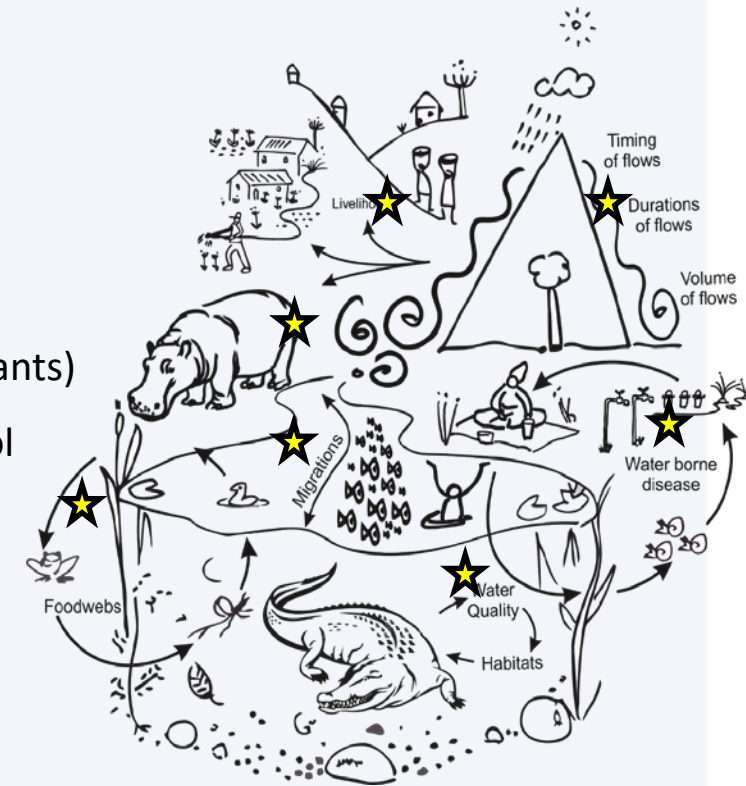


SOCIAL

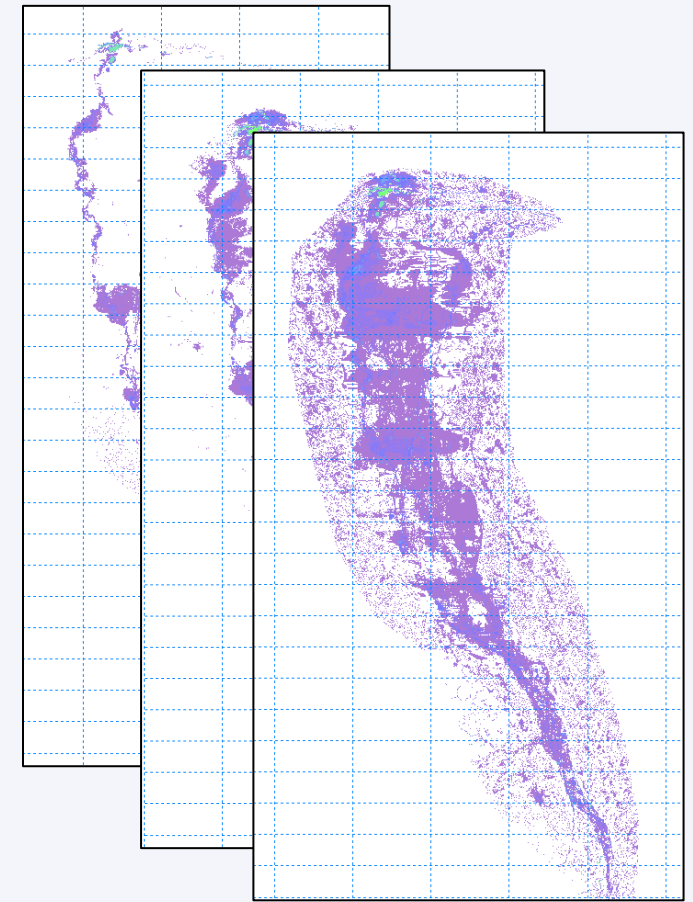
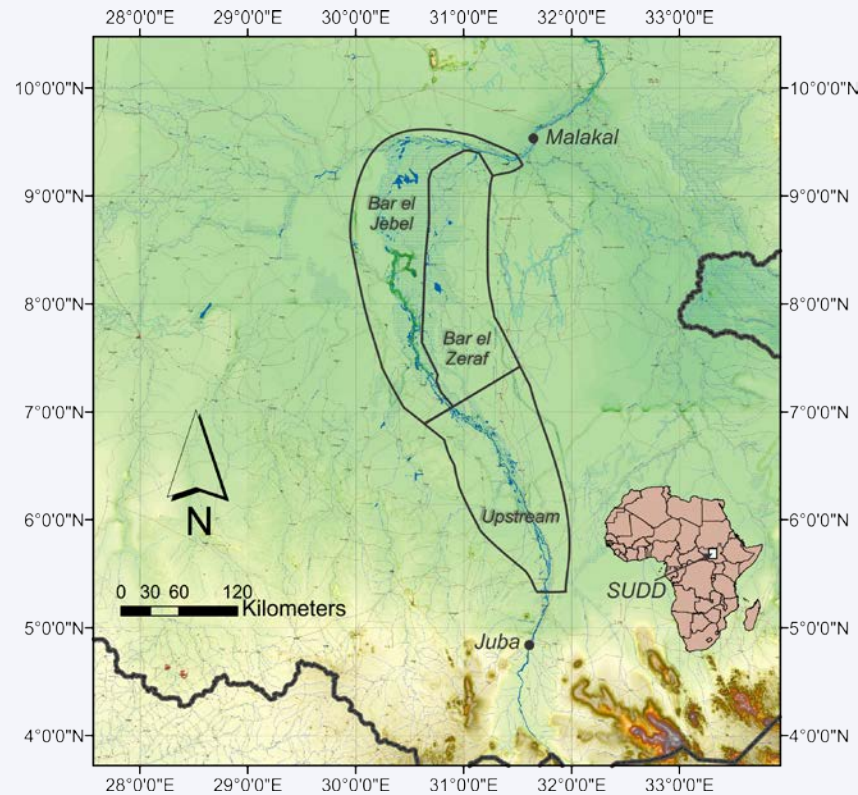
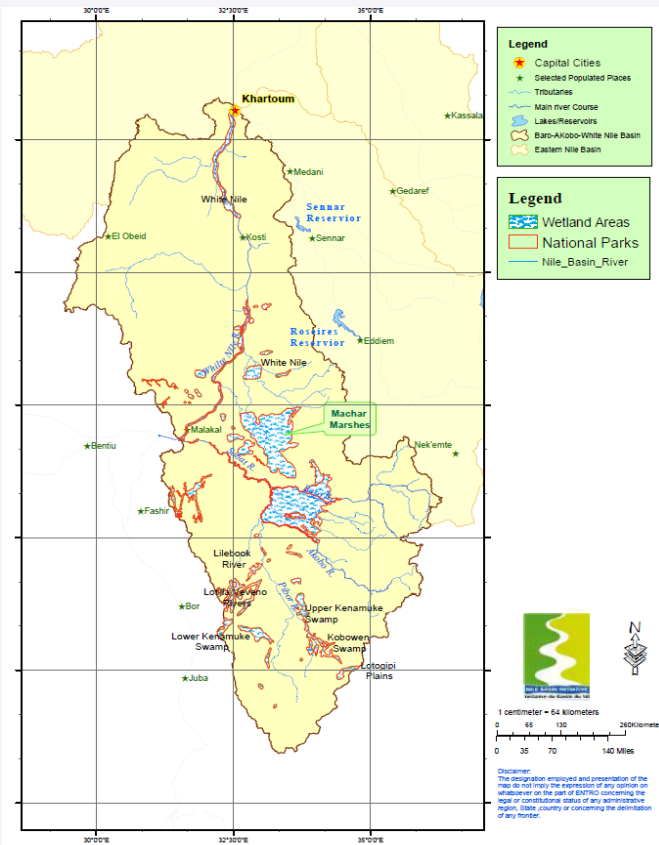
- Fisheries
- Grazing
- Navigation
- Harvesting (plants)
- Disease control

ECOLOGICAL

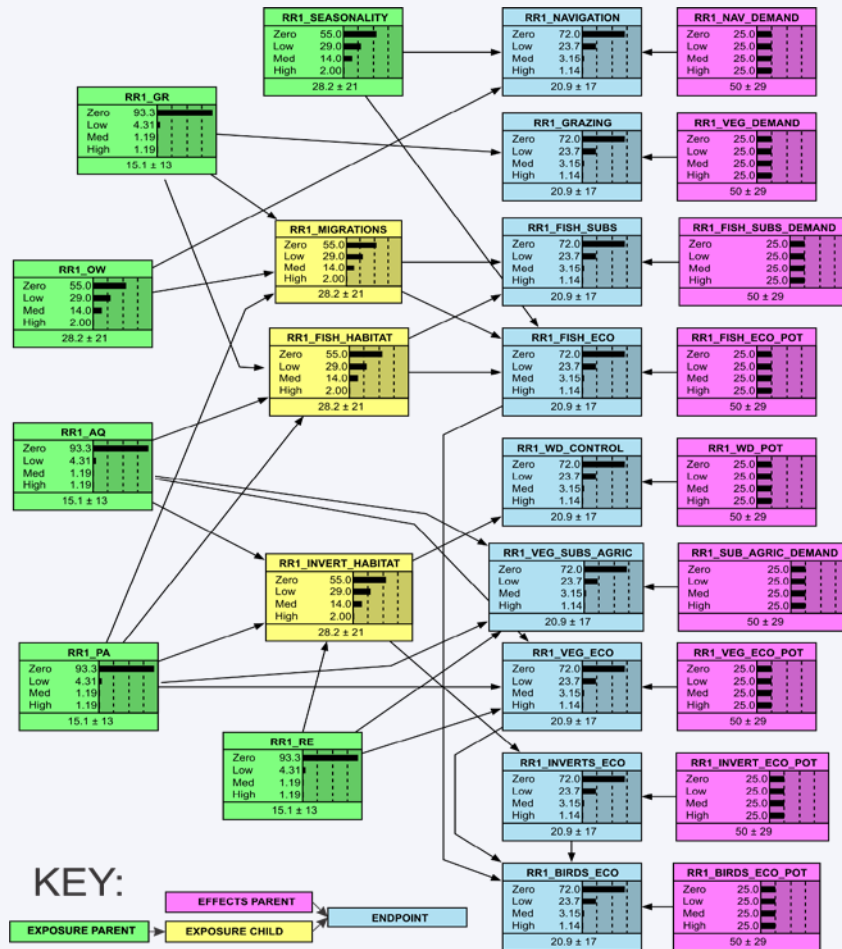
- Fish
- Invertebrates
- Vegetation
- Birds (aquatic and migratory)



Environmental flows in the Sudd

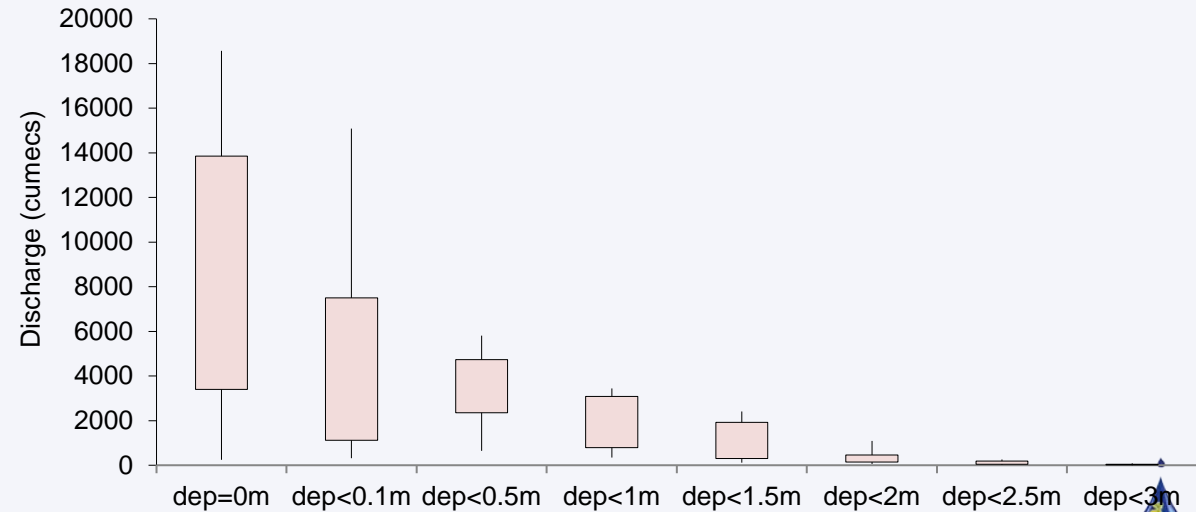
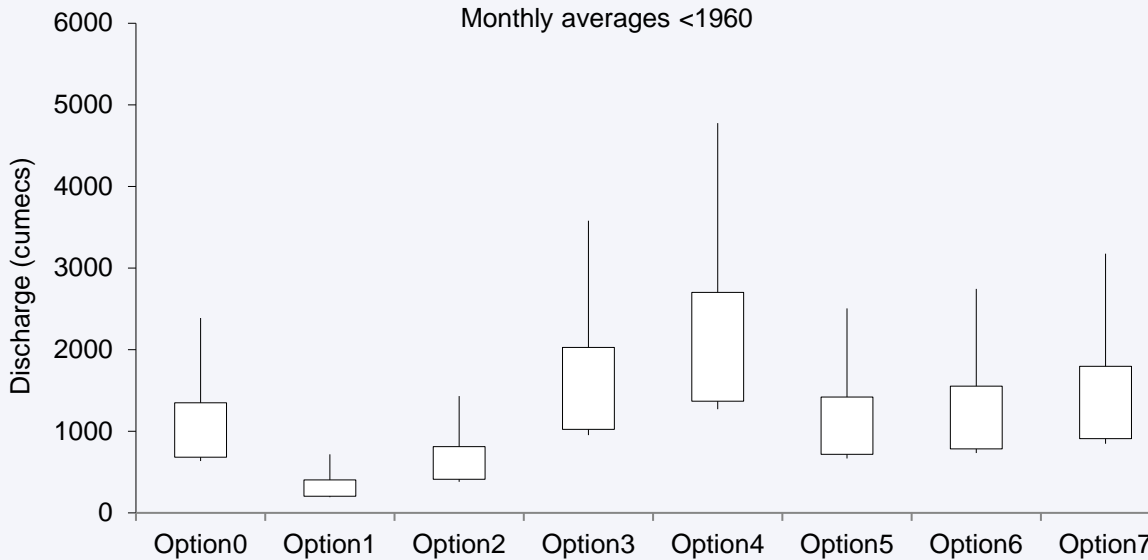
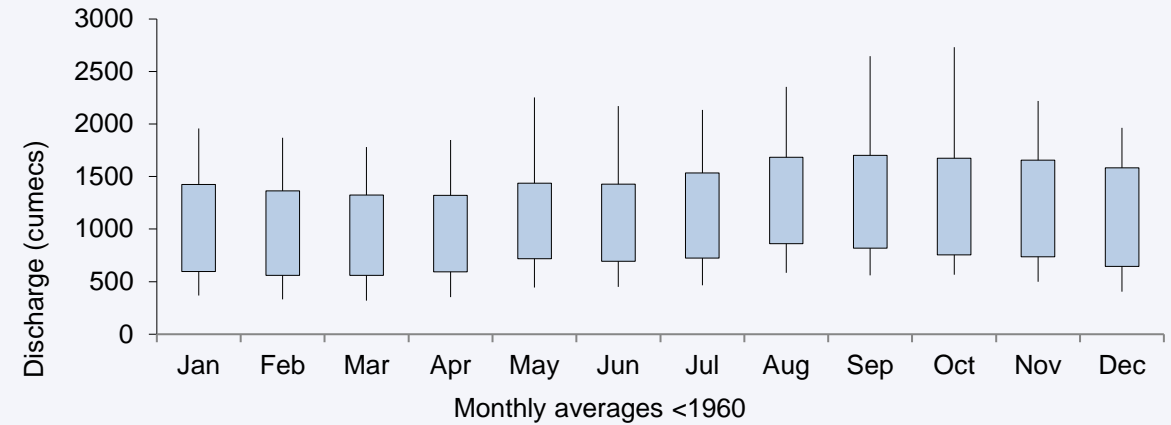
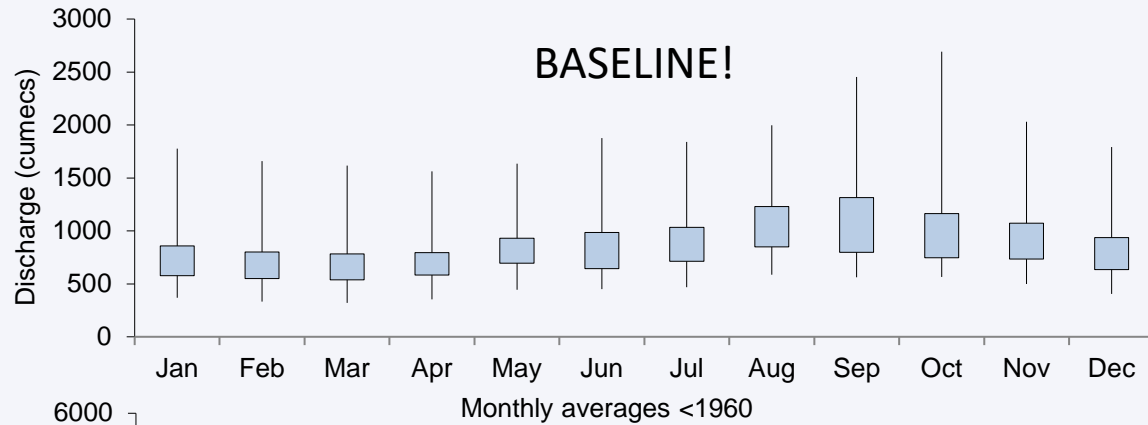


Environmental flows in the Sudd

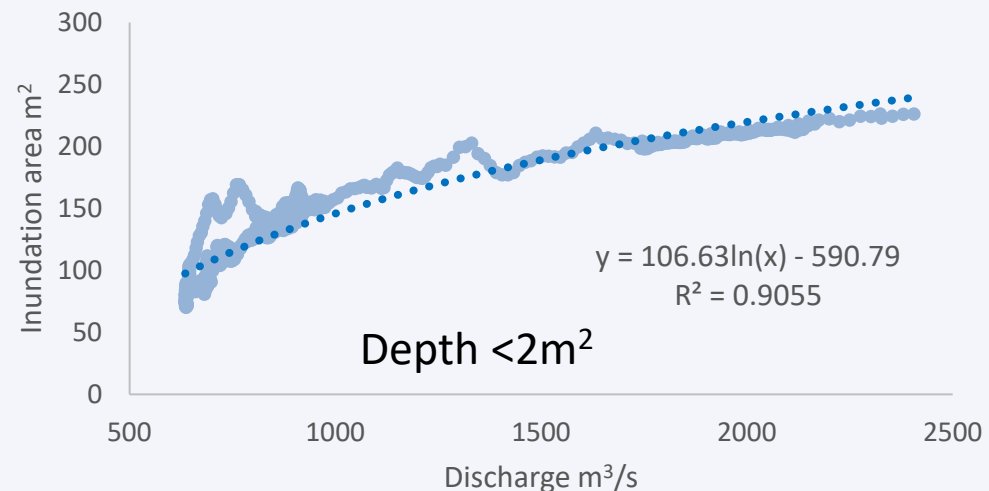
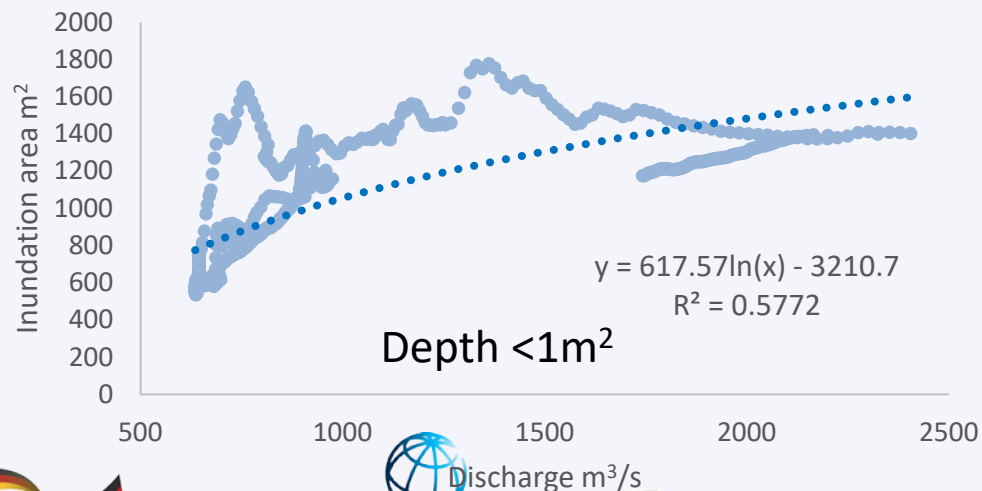
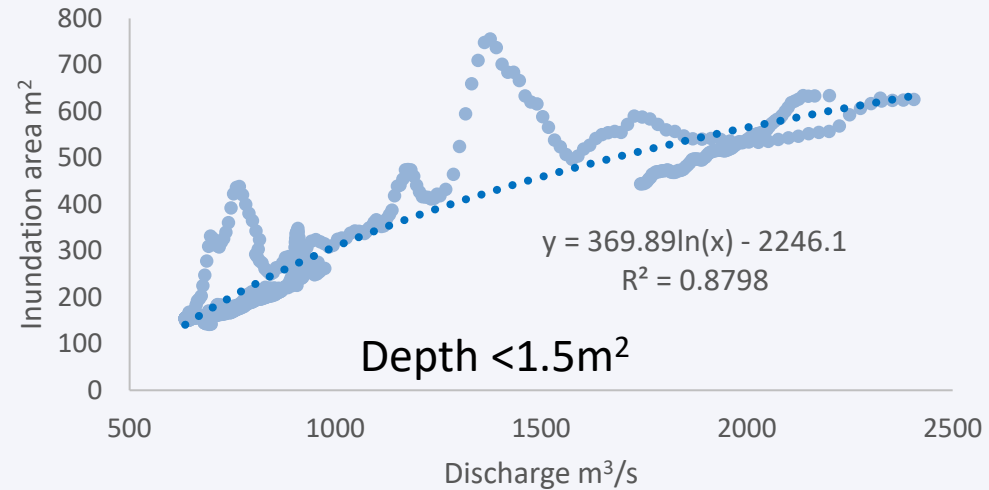
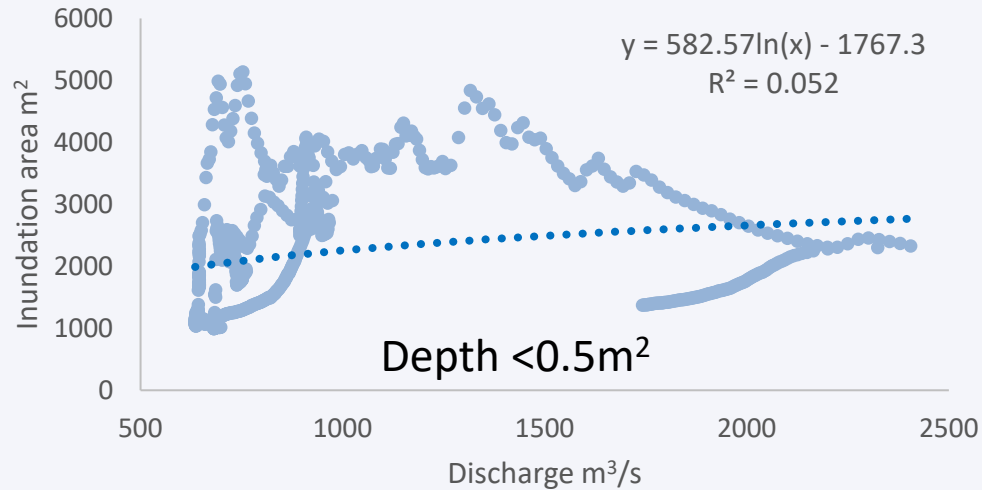


ABRV	Meaning
RR1	Risk Region 1
OW	Open water
AQ	Aquatic vegetation
PA	Papyrus
RE	Reed beds
GR	Flooded grassland
INVERT	Invertebrate
VEG	Vegetation
ECO	Ecosystem
SUBS	Subsistence
NAV	Navigation
WD	Water disease
AGRIC	Agriculture
POT	Potential

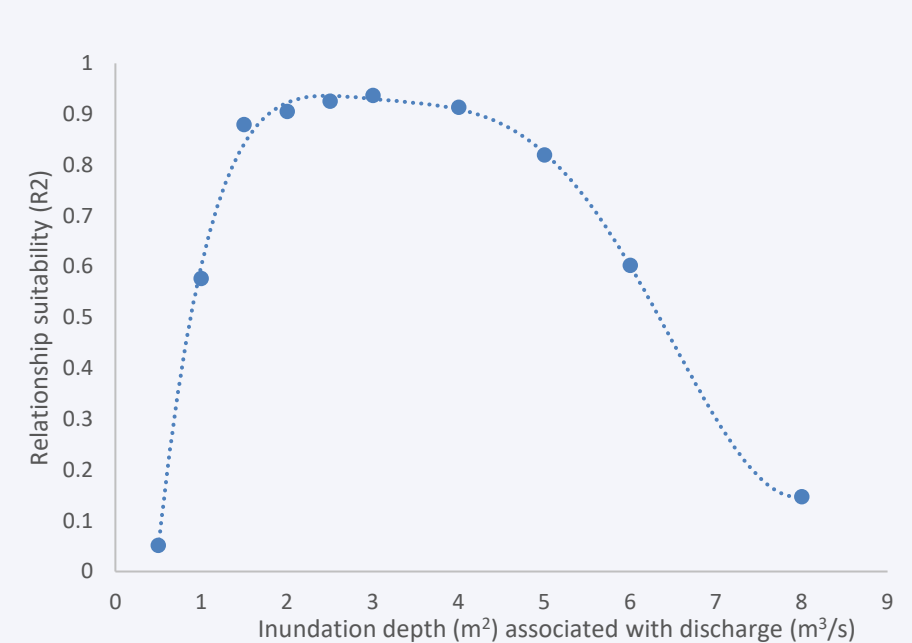
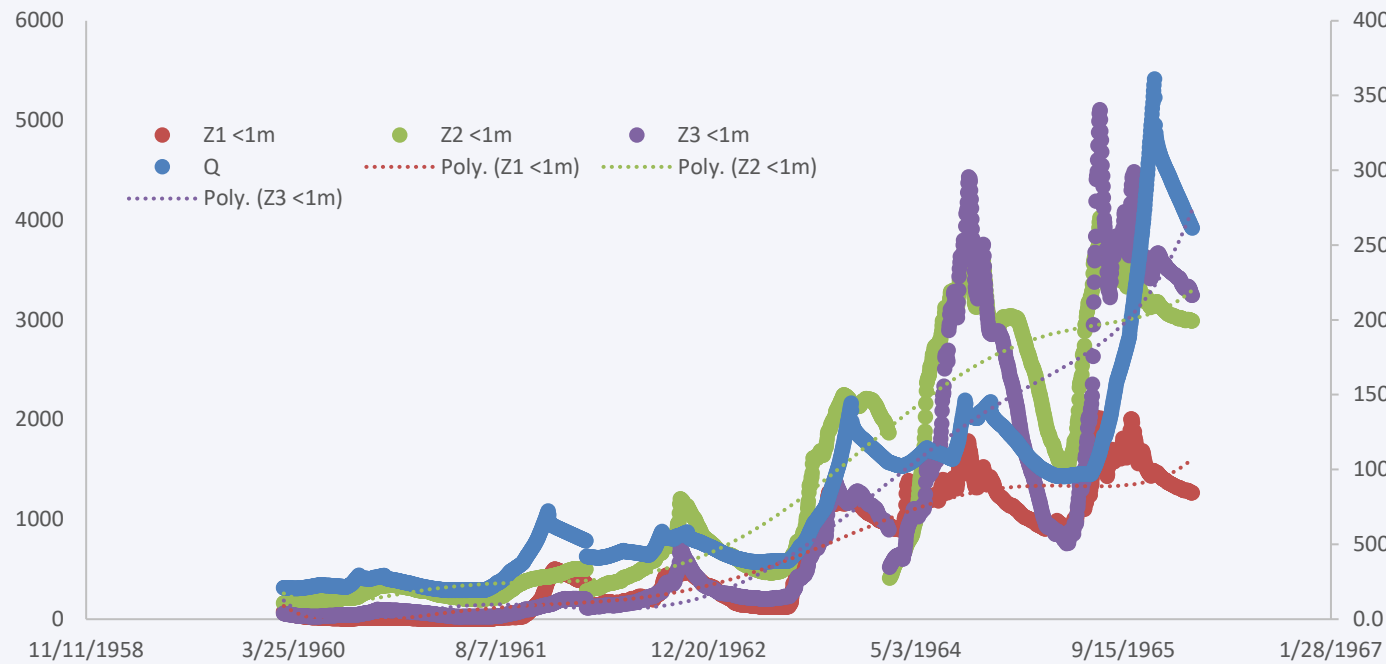
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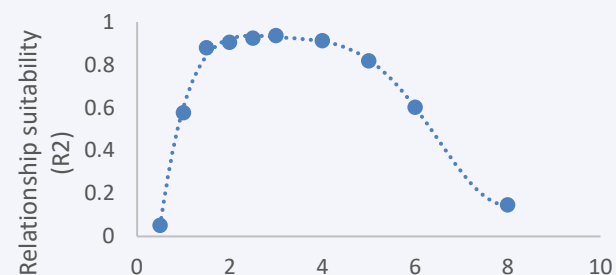
Depth (max)	Inundation Duration (% Year)																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0	TR	TR	TR	TR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	RE	RE	PA
0.25	TR	TR	TR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	RE	RE	RE	RE	RE	RE	PA
0.5	TR	TR	GR	GR	GR	RE	RE	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA
0.75	TR	GR	GR	GR	GR	RE	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA
1	TR	GR	GR	GR	GR	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	FR
1.25	GR	GR	GR	GR	GR	RE	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	FR	FR	FR	AQ
1.5	GR	GR	GR	RE	RE	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	AQ	AQ	AQ	AQ	OW
1.75	GR	GR	GR	PA	PA	PA	PA	PA	PA	FR	FR	AQ	AQ	AQ	AQ	AQ	AQ	OW	OW	OW
2	GR	RE	RE	PA	PA	PA	FR	FR	FR	FR	FR	AQ	AQ	AQ	AQ	AQ	OW	OW	OW	OW
2.25	GR	RE	RE	PA	PA	FR	FR	FR	AQ	AQ	AQ	AQ	AQ	AQ	OW	OW	OW	OW	OW	OW
2.5	RE	RE	PA	PA	FR	AQ	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
2.75	RE	PA	PA	PA	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
3	RE	PA	PA	PA	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
Days	18.25	36.5	54.75	73	91.25	109.5	127.8	146	164.3	182.5	200.8	219	237.3	255.5	273.8	292	310.3	328.5	346.8	365

	OW	AQ	FR	PA	RE	GR	TR
0	0	0	0	1	2	13	3
0.25	0	0	0	1	6	10	2
0.5	0	0	0	12	3	3	1
0.75	0	0	0	13	2	4	0
1	0	0	3	11	1	4	0
1.25	0	1	5	8	1	4	0
1.5	1	4	3	7	2	2	0
1.75	2	6	2	7	0	2	0
2	3	6	5	3	2	0	0
2.25	5	7	3	2	2	0	0
2.5	14	1	1	2	1	0	0
2.75	16	0	0	3	0	0	0
3	16	0	0	3	0	0	0

	OW		AQ		FR		PA		RE		GR		TR	
	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)
ZERO/LOW	2.5		1.75	2.25	1.25	2	0.5	1.25	0.1	0.25	0.1	0.1	0.05	0.1
LOW/MOD	1.75		1.5	2.5	1.5	2.5	0.25	1.75	0	0.5	0	1	0	0.25
MOD/HIGH	1.5		1.25	2.75	1	2.75	0	3		1.5		2		0.5

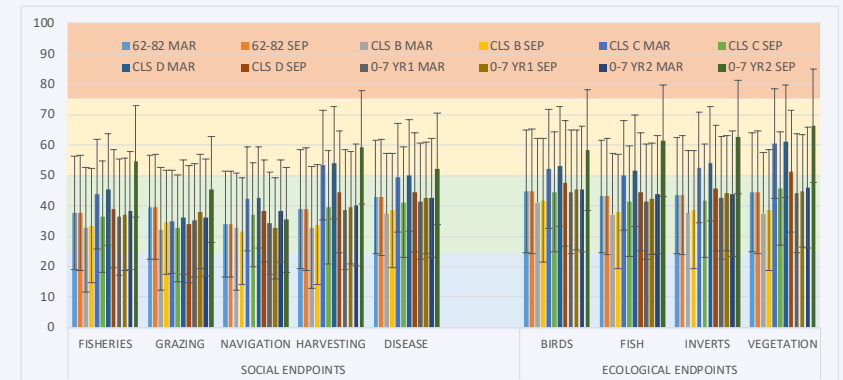
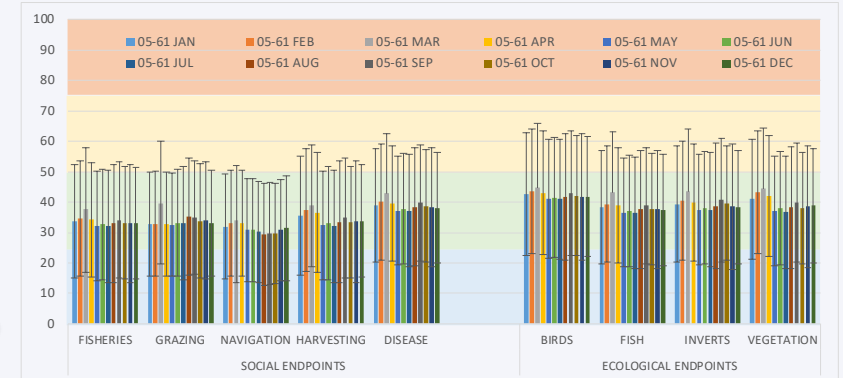
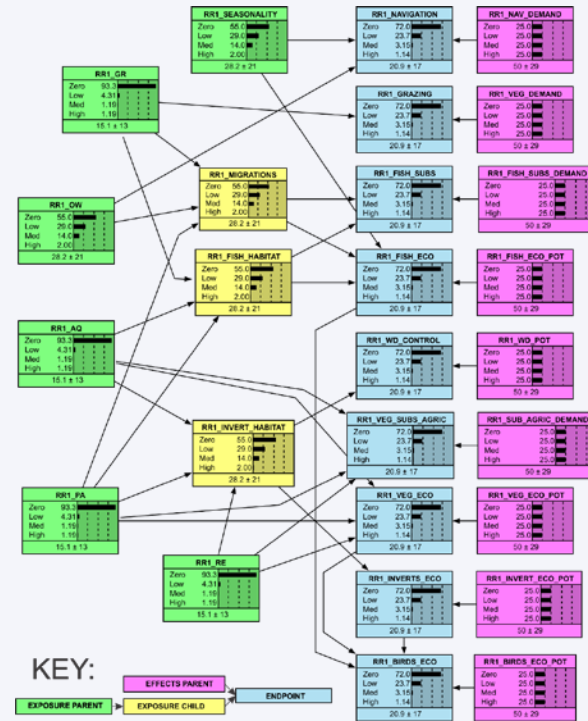
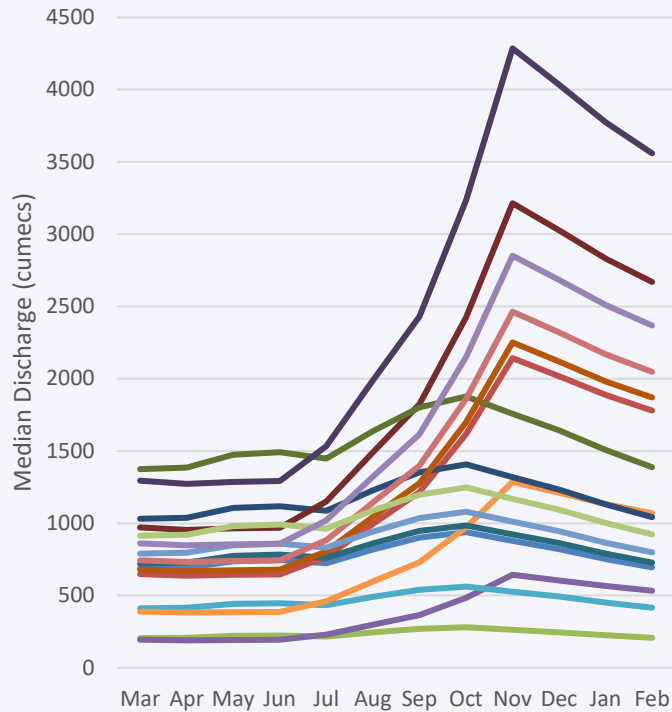
	OW		AQ		FR		PA		RE		GR		TR	
	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)	Low (m)	high (m)
ZERO/LOW	910		730	850	630	780	520	630	425	480	425	425	380	425
LOW/MOD	730		680	910	680	910	480	730	400	520	400	590	400	480
MOD/HIGH	680		630	980	590	980	400	1050		680		780		590

- 0.1 $y = 4859\ln(x) - 26398$
- 1 $y = 617.57\ln(x) - 3210.7$
- 1.5 $y = 369.89\ln(x) - 2246.1$
- 2 $y = 106.63\ln(x) - 590.79$
- 2.5 $y = 61.821\ln(x) - 383.2$
- 3 $y = 17.842\ln(x) - 106.86$
- 4 $y = 11.265\ln(x) - 63.883$
- 5 $y = 4.4517\ln(x) - 24.658$

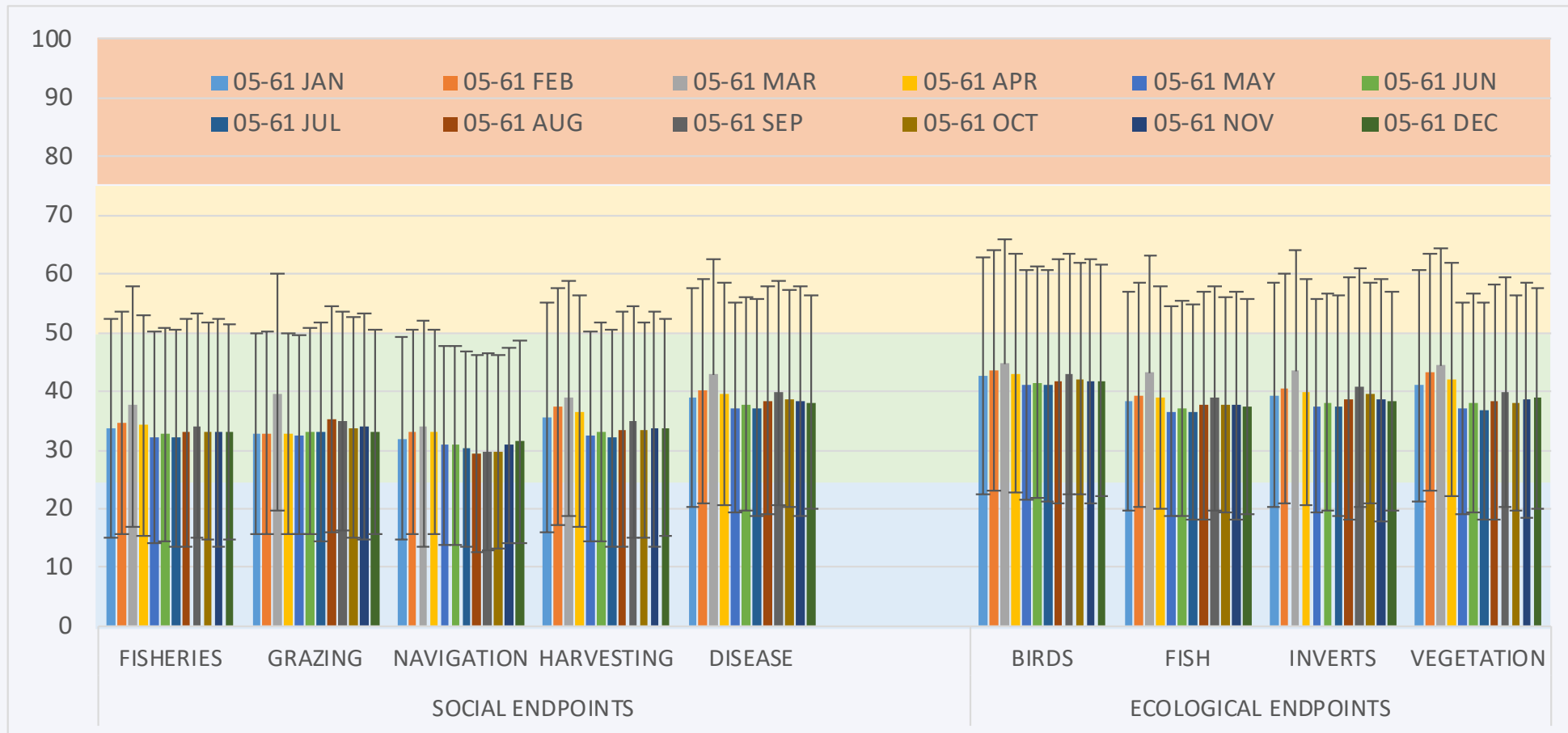


Inundation depth (m²) associated with...

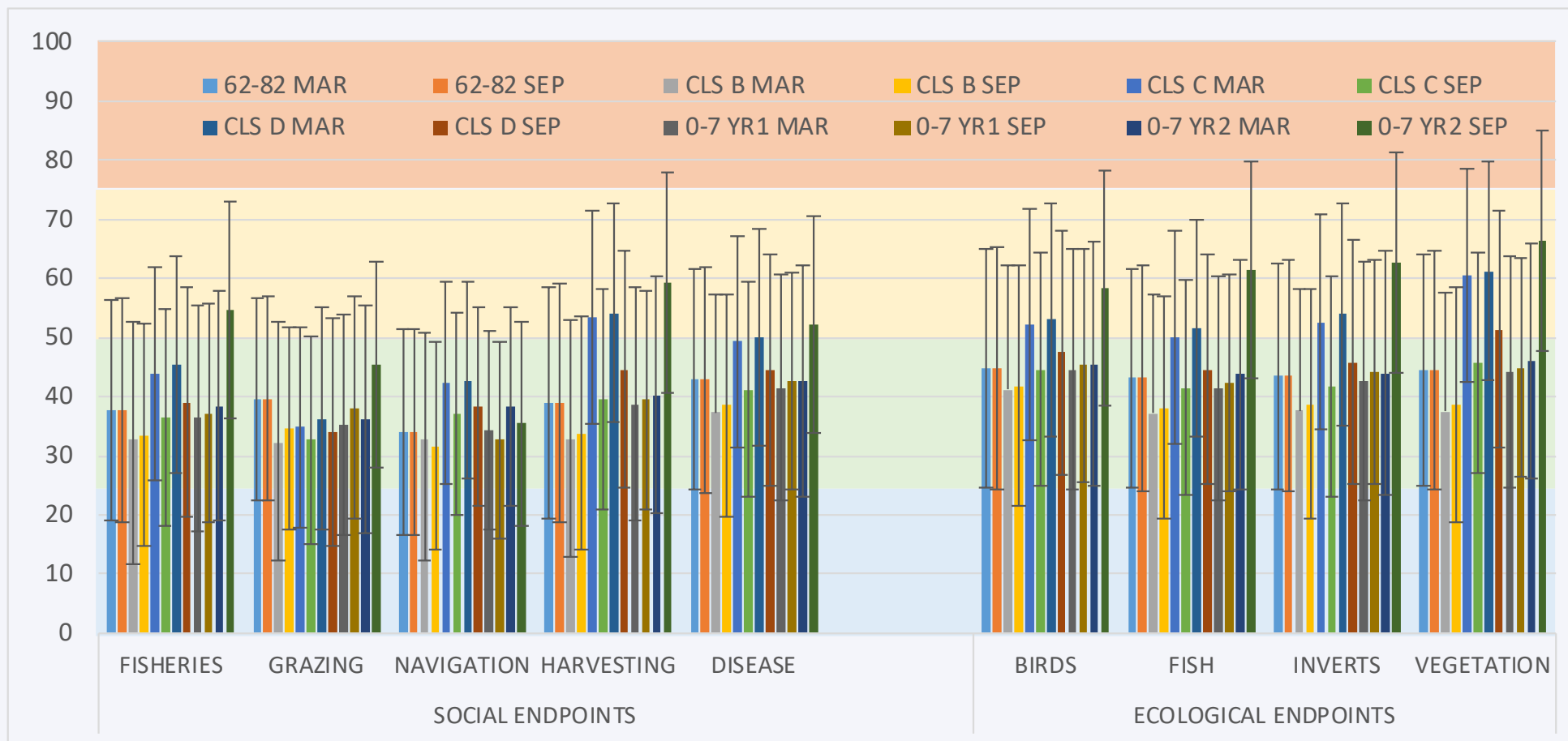
Environmental flows in the Sudd



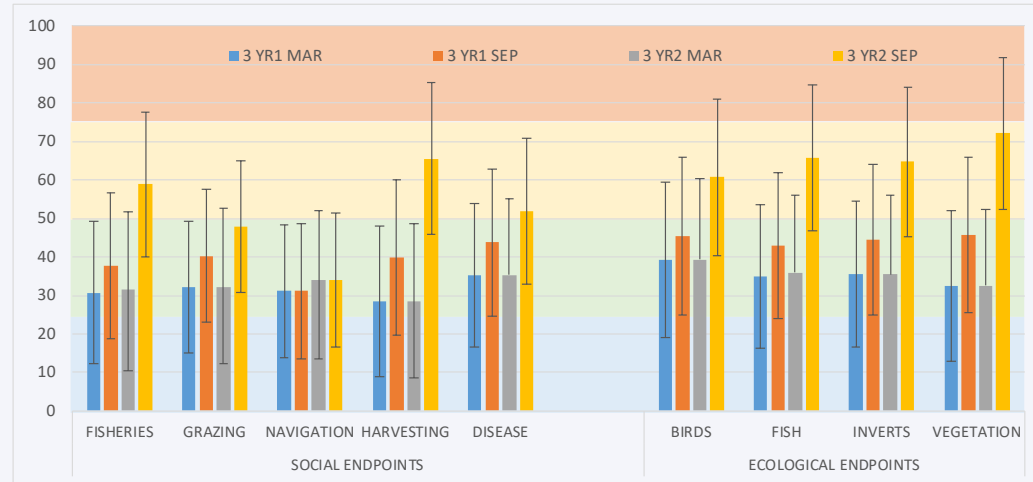
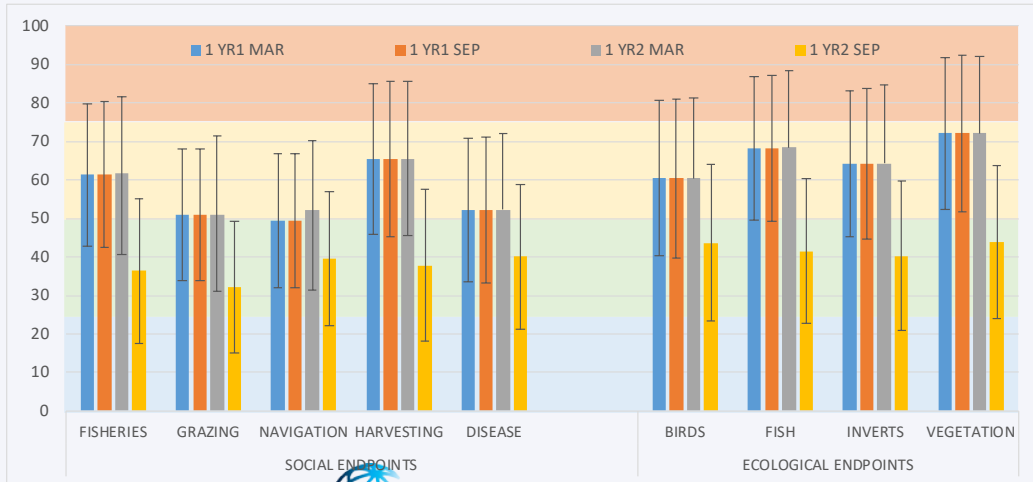
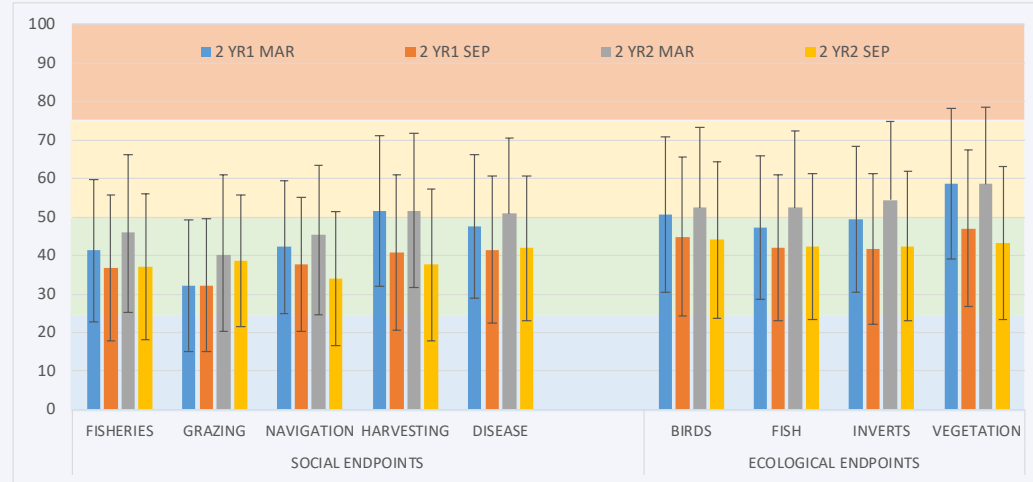
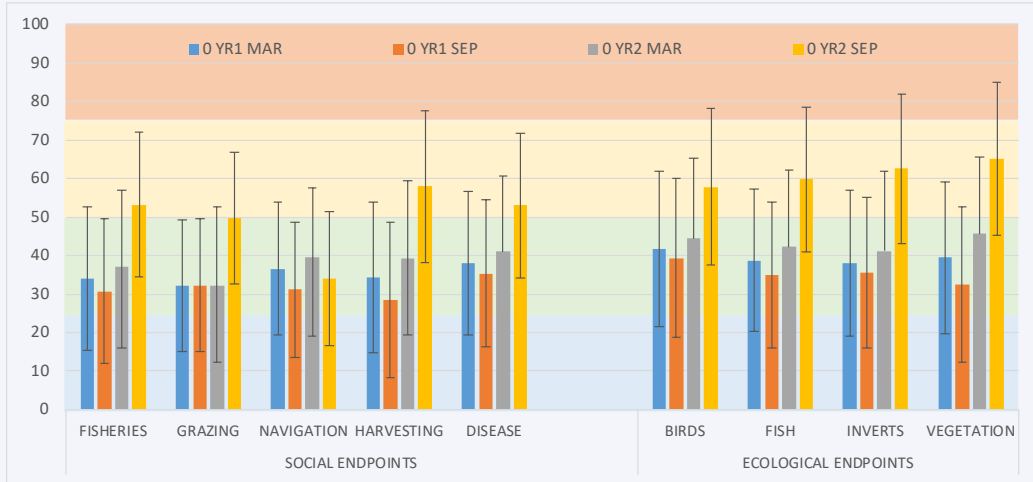
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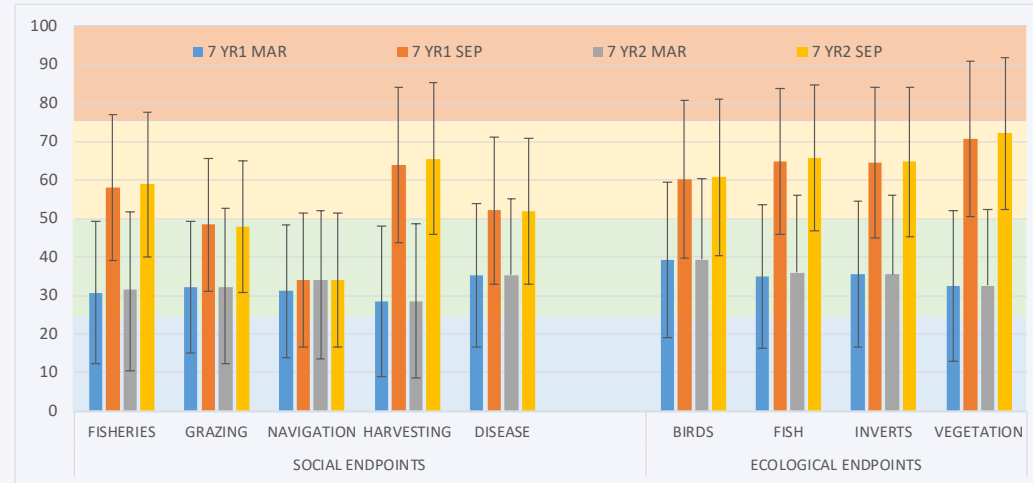
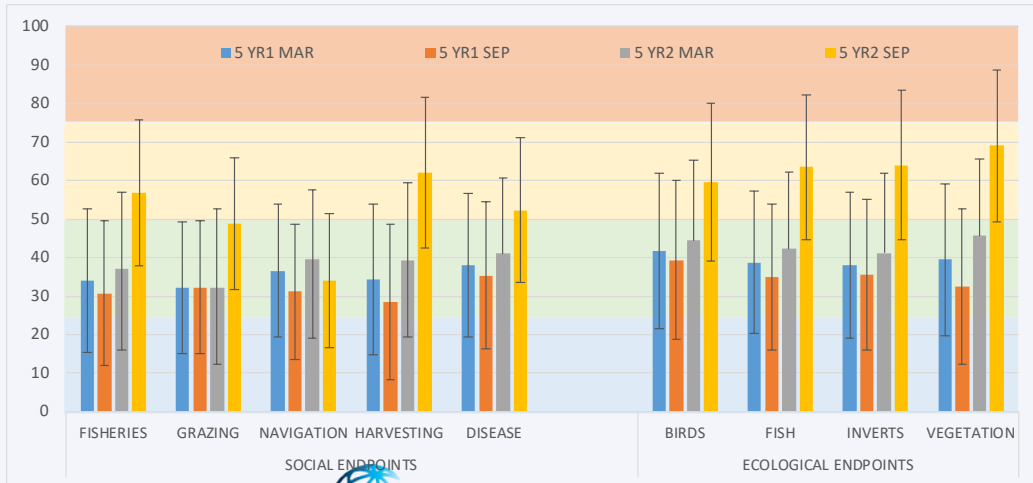
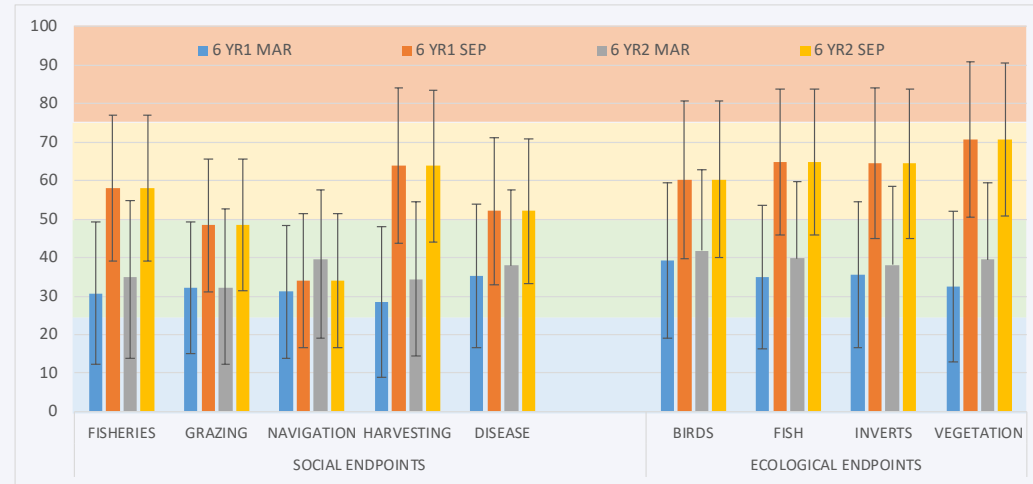
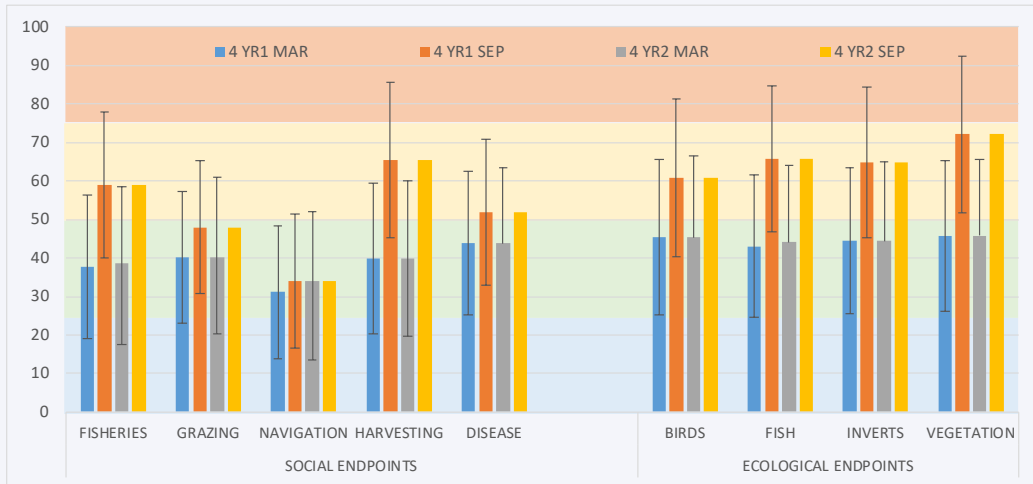
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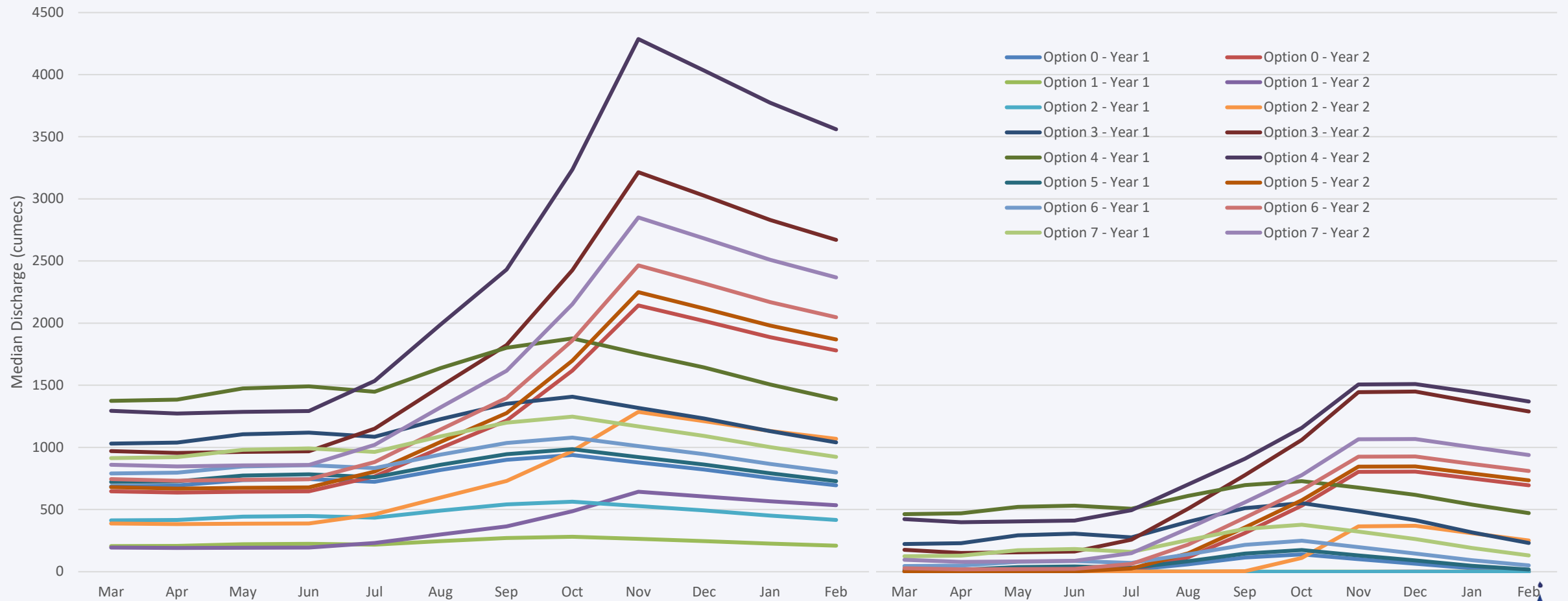
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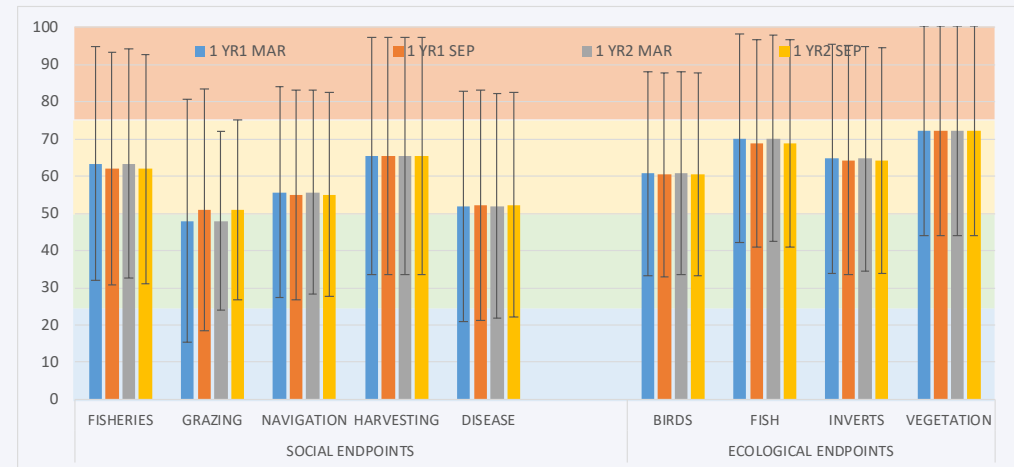
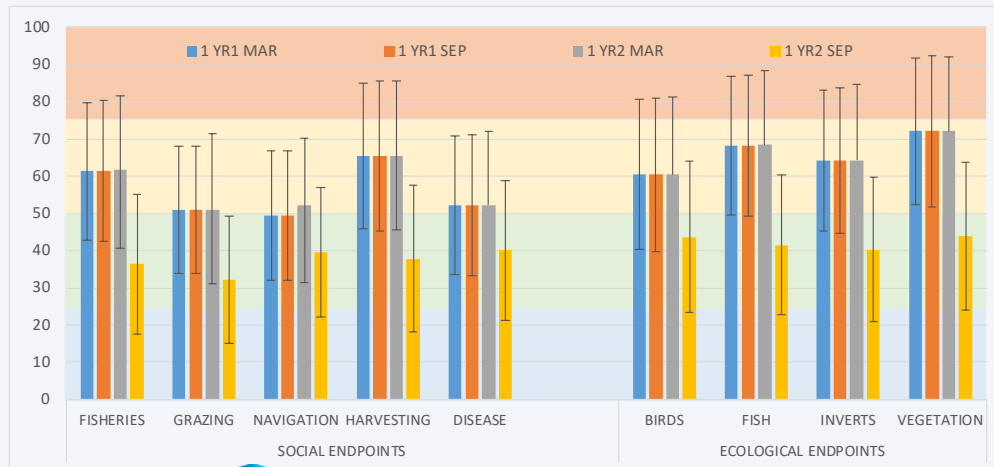
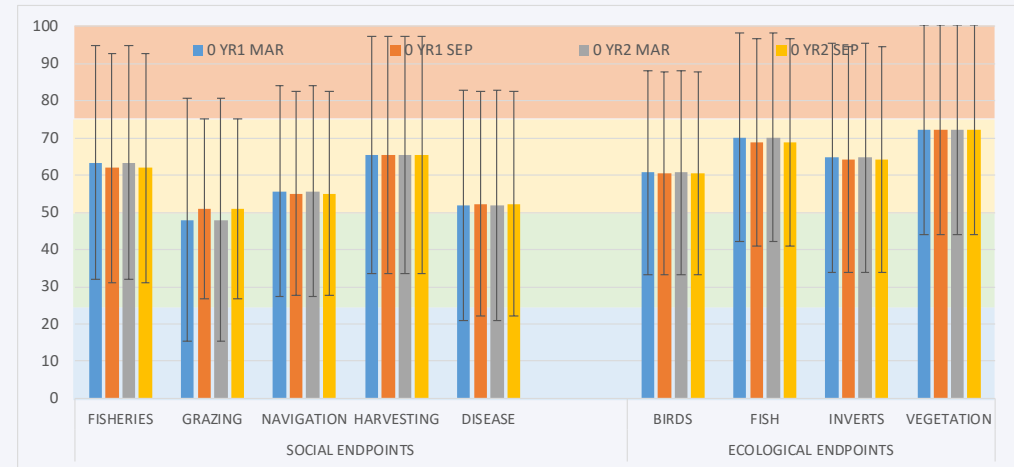
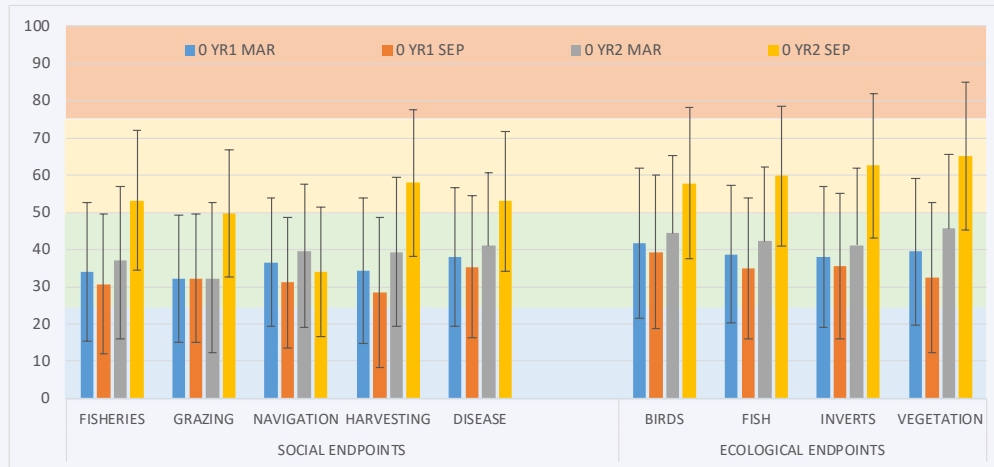
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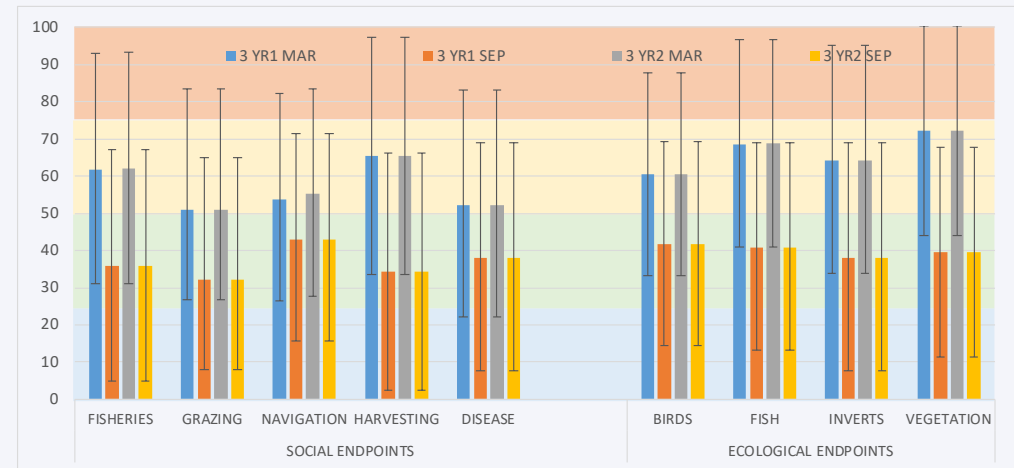
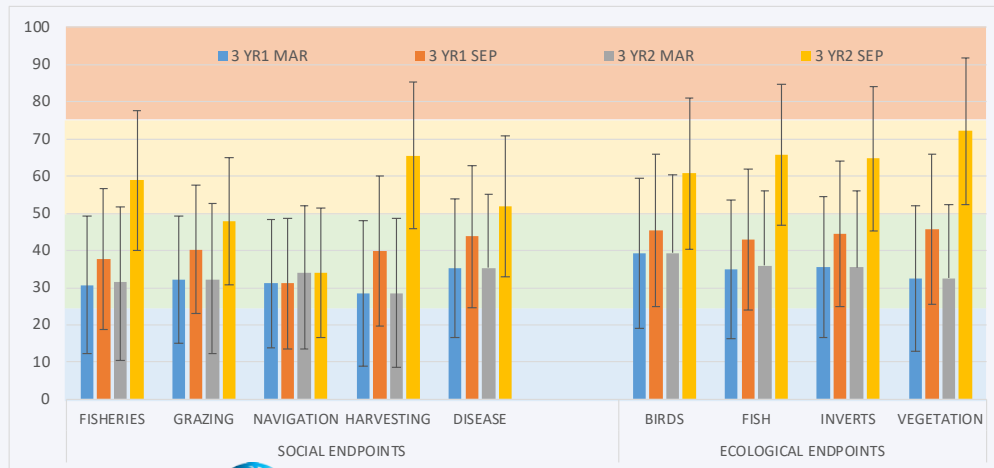
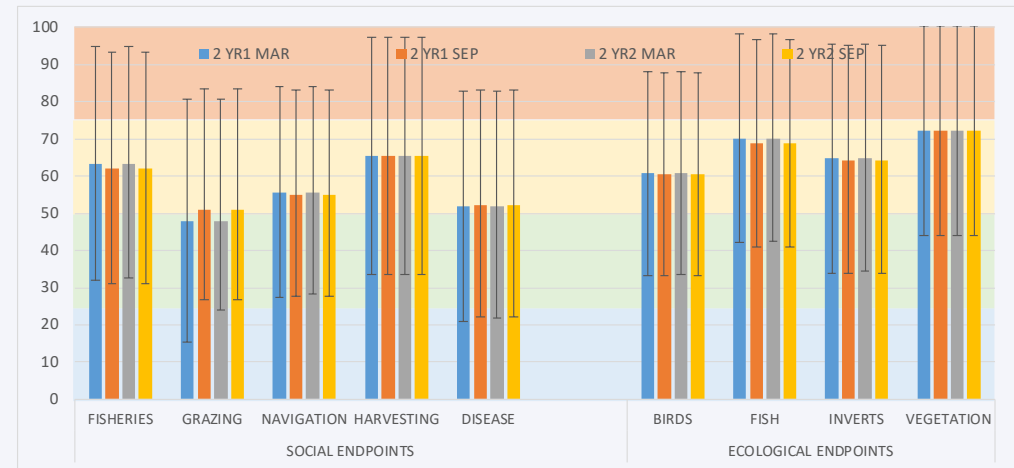
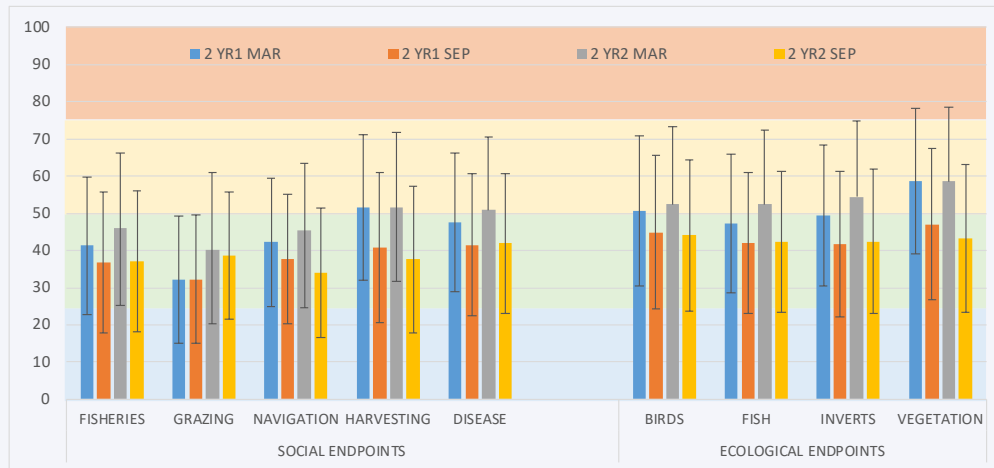
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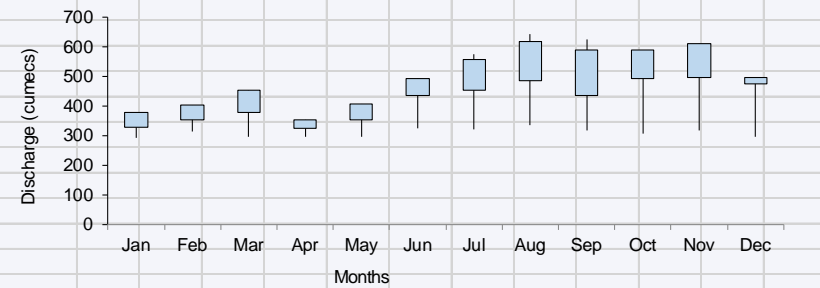
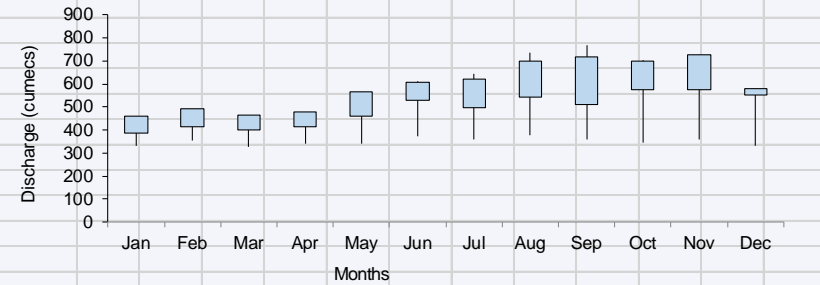


Environmental flows in the Sudd



Environmental flows in the Sudd

Normal year													Drought year												
Percentiles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Percentiles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.1	460.7	493.9	463.6	479.6	565.4	609.7	642.2	733.2	765.5	701.9	727.4	578.5	0.1	378.6	404.7	453.8	352.7	408.7	492.8	574.2	644.8	625.3	589.3	611	497.7
1	460.7	493.9	463.6	479.6	565.4	609.7	642.2	733.2	765.5	701.9	727.4	578.5	1	378.6	404.7	453.8	352.7	408.7	492.8	574.2	644.8	625.3	589.3	611	497.7
5	460.7	493.9	463.6	479.6	565.4	609.7	642.2	733.2	765.5	701.9	727.4	578.5	5	378.6	404.7	453.8	352.7	408.7	492.8	574.2	644.8	625.3	589.3	611	497.7
10	460.7	493.9	463.6	479.6	565.4	609.7	634.4	721.5	749	701.9	727.4	578.5	10	378.6	404.7	453.8	352.7	408.7	492.8	568.5	636.1	613.1	589.3	611	497.7
15	460.7	493.9	463.6	479.6	565.4	609.7	626.8	710	733	701.9	727.4	578.5	15	378.6	404.7	453.8	352.7	408.7	492.8	562.9	627.7	601.3	589.3	611	497.7
20	460.2	493.4	463.1	479.2	564.7	609.2	619.2	698.7	717.6	700.9	726.3	578.3	20	378.3	404.4	453.3	352.5	408.4	492.4	557.2	619.2	590	588.5	610.2	497.5
30	458.1	491.1	461.4	477.4	561.8	606.9	604.6	677.4	693.9	696.6	718.8	577.5	30	377	402.9	451.4	351.8	407	490.8	546.1	603.1	572.5	585.2	604.2	496.8
40	454.5	484.6	457.6	472.9	557.7	603.9	589.2	661.1	661.4	687.3	711.5	576.4	40	374.6	398.7	446.9	350.1	404.9	488.7	533.8	590.5	548.3	577.8	598.4	495.9
50	448.9	479.6	454	469	549.7	598.6	579.8	645.5	647.6	678.3	687.6	575.3	50	371	395.6	442.7	348.6	400.9	484.9	526.0	578.0	538.0	570.6	579.4	495.1
60	435.6	468.3	447	458.7	534.3	589.8	561.3	612.8	593.6	648.5	659.1	573.2	60	362.4	388.3	434.5	344.6	393.2	478.8	510.8	551.7	497.6	547	556.8	493.4
70	414.7	444.3	427.7	442.5	505.7	566.3	533.2	590.3	565.1	612.6	604.3	566.5	70	348.9	373	412	338.3	378.9	462.1	485.9	532.7	475.9	518.6	515.4	487.9
80	385.2	412.4	400	413.9	459.8	528	498.9	541.4	512.3	574.4	573.9	550	80	329.8	352.6	379.9	327.2	355.9	435.1	453.5	487.6	435.5	494.9	495.6	474.4
85	369.1	395	382.4	395.7	430.5	499.8	473.7	511.7	478.7	571.1	559.7	536.3	85	319.4	341.4	359.4	320.1	341.3	415.2	429.6	460.1	409.8	492.2	484	463.3
90	353.7	378.4	363.3	375.9	398.6	464.3	441.8	474.2	442	564.6	534	511.6	90	309.5	330.8	337.1	312.4	325.3	390.1	399.5	425.6	381.7	486.9	462.9	443.1
95	340.6	364.3	344.1	356	366.7	421.4	403.4	428.9	404.5	539.5	478.6	458.1	95	301	321.8	314.7	304.7	309.4	359.9	363.2	383.9	353.1	466.3	417.6	399.4
99	333	356.1	330.7	342.2	344.5	383	369	388.4	366.5	381.3	379.3	355.5	99	296.1	316.5	299.2	299.3	298.3	332.7	330.6	346.5	324.1	336.4	335.8	315.7
99.9	331.3	354.2	327.7	339.1	339.5	374.3	361.2	379.2	358	345.7	357	332.4	99.9	295	315.3	295.7	298.1	295.8	326.6	323.2	338	317.5	307.2	317.3	296.9





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**THANK
YOU!**

