Supplement 2

results

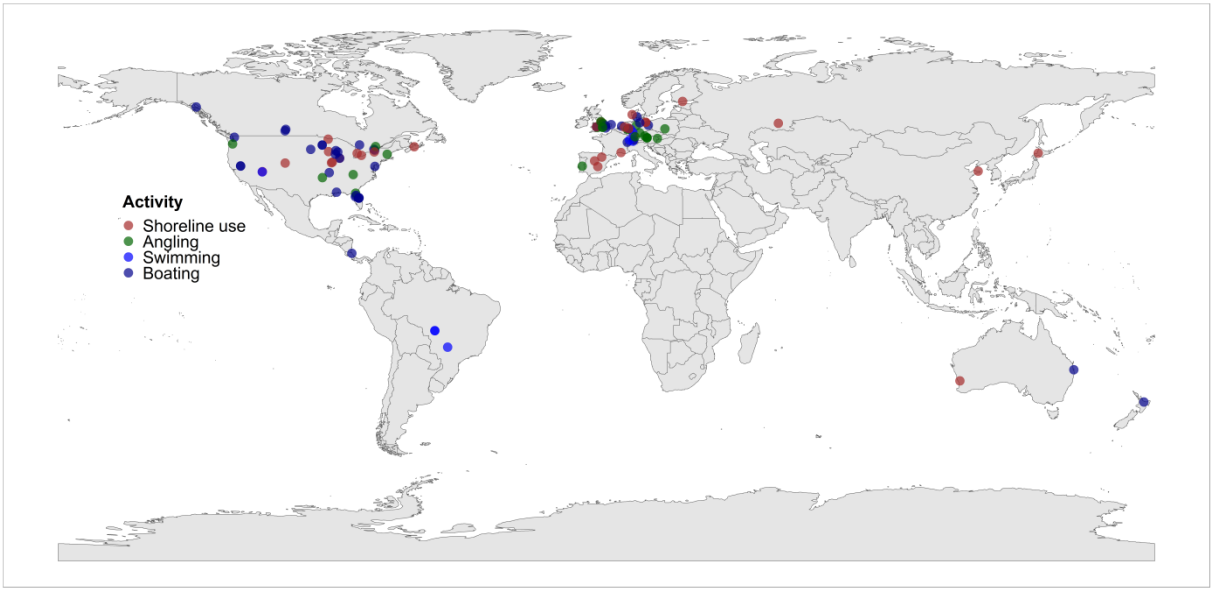

Figure S 1: Locations of study sites or laboratories for all 94 studies included in the meta-analysis color-coded by categories of recreational activities. As dots are transparent, more intense colour indicates multiple studies overlapping due to close proximities of location.

Table S 1: Number of studies per country as ISO 3166-1 alpha-3 codes

(unstats.un.org/unsd/tradekb/Knowledgebase/50347/Country-Code)

Country	Number of studies				
	Total	Shoreline use	Angling	Swimming	Boating
USA	31	9	5	1	17
DEU	21	8	8	2	4
GBR	12	3	6	0	5
CAN	8	3	1	0	4
BRA	3	0	0	3	0
CHE	3	0	0	2	1
ESP	3	3	0	0	0
AUS	2	1	0	0	1
DNK	2	1	0	0	1
AUT	1	0	1	0	0
CRI	1	0	0	0	1
FIN	1	1	0	0	0
FRA	1	1	0	0	0
JPN	1	1	0	0	0
NLD	1	0	0	0	1
NZL	1	0	0	0	1
PRT	1	0	1	0	0
RUS	1	1	0	0	0

Table S 2: Variance components of multilevel meta-analysis

		estim	sqrt	nlvls	fixed	factor
Overall	σ_1^2	0.11	0.34	94	no	Study_ID
	σ_2^2	0.02	0.14	108	no	Study_ID/taxa
	σ_3^2	0.26	0.51	145	no	Study_ID/taxa/Response.measured
Shoreline use	σ_1^2	0.71	0.84	31	no	Study_ID
	σ_2^2	0.07	0.26	36	no	Study_ID/taxa
	σ_3^2	0.03	0.18	46	no	Study_ID/taxa/Response.measured
Angling	σ_1^2	0.16	0.40	23	no	Study_ID
	σ_2^2	0.14	0.36	29	no	Study_ID/taxa
	σ_3^2	0.34	0.58	40	no	Study_ID/taxa/Response.measured
Swimming	σ_1^2	0.03	0.18	8	no	Study_ID
	σ_2^2	0.0006	0.03	9	no	Study_ID/taxa
	σ_3^2	0.52	0.72	17	no	Study_ID/taxa/Response.measured
Boating	σ_1^2	0.06	0.25	36	no	Study_ID
	σ_2^2	0	0.0001	38	no	Study_ID/taxa
	σ_3^2	0.08	0.29	46	no	Study_ID/taxa/Response.measured

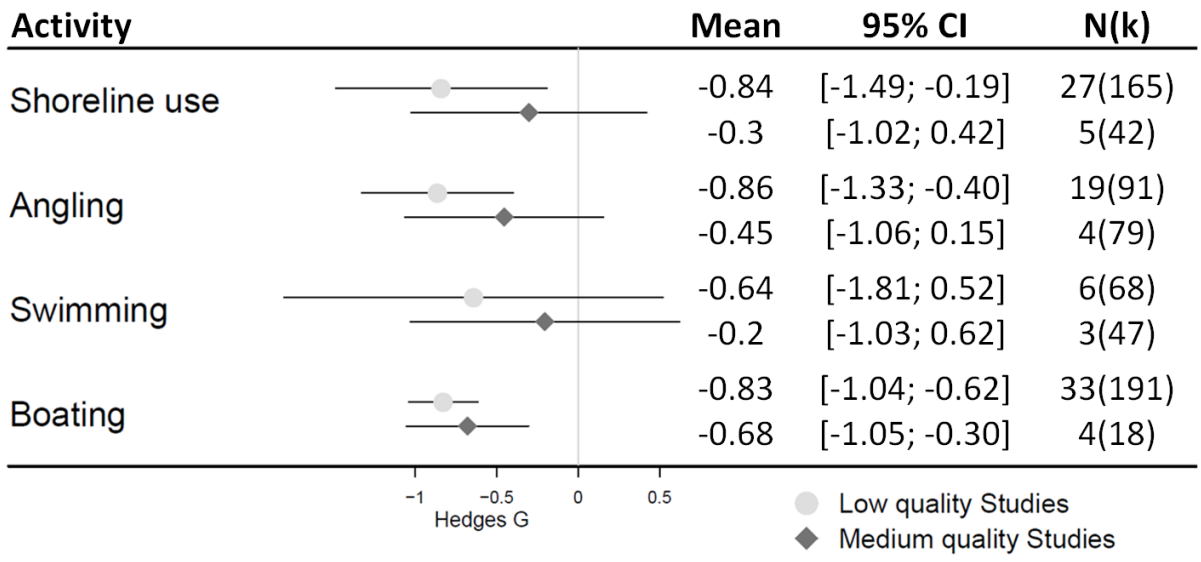

Figure S 2: Forest plot with comparison of mean effect sizes between studies categorized as low validity (circles) and studies categorized as medium validity (diamonds) for each of the four recreational activities. Shown are the mean summary effect size (Mean), the 95% confidence interval (95% CI), number of Studies (N) and number of effect sizes (k). Effects are significant if the 95% CI (horizontal lines) does not overlap the vertical zero line.

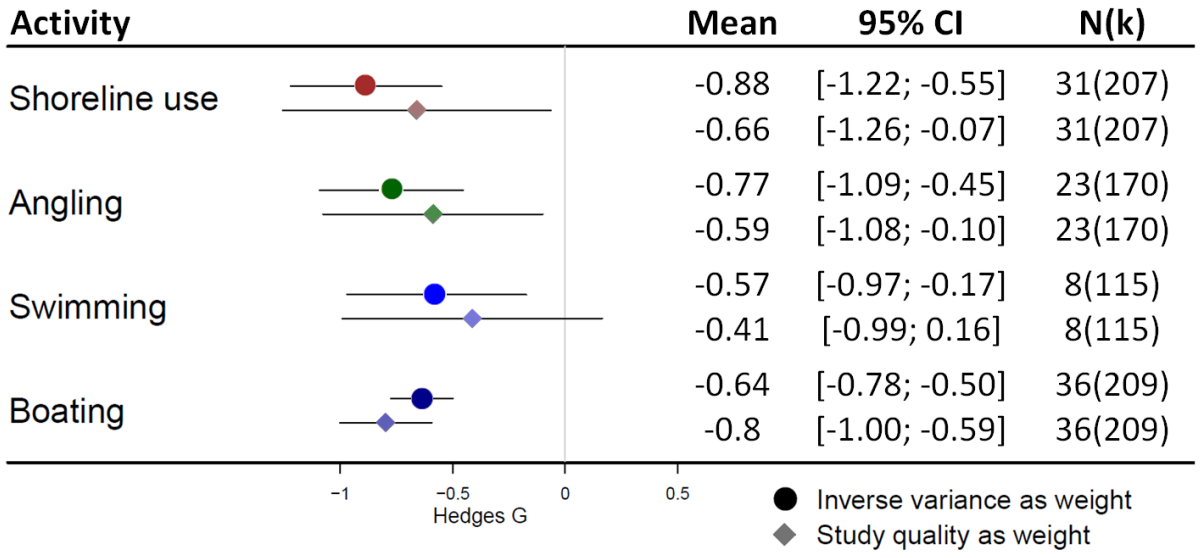

Figure S 3: Forest plot with comparison of mean effect sizes between models with inverse variance as weight (circles) and models with study quality as weight (diamonds) for each of the four recreational activities. Shown are the mean summary effect size (Mean), the 95% confidence interval (95% CI), number of Studies (N) and number of effect sizes (k). Effects are significant if the 95% CI (horizontal lines) does not overlap the vertical zero line.

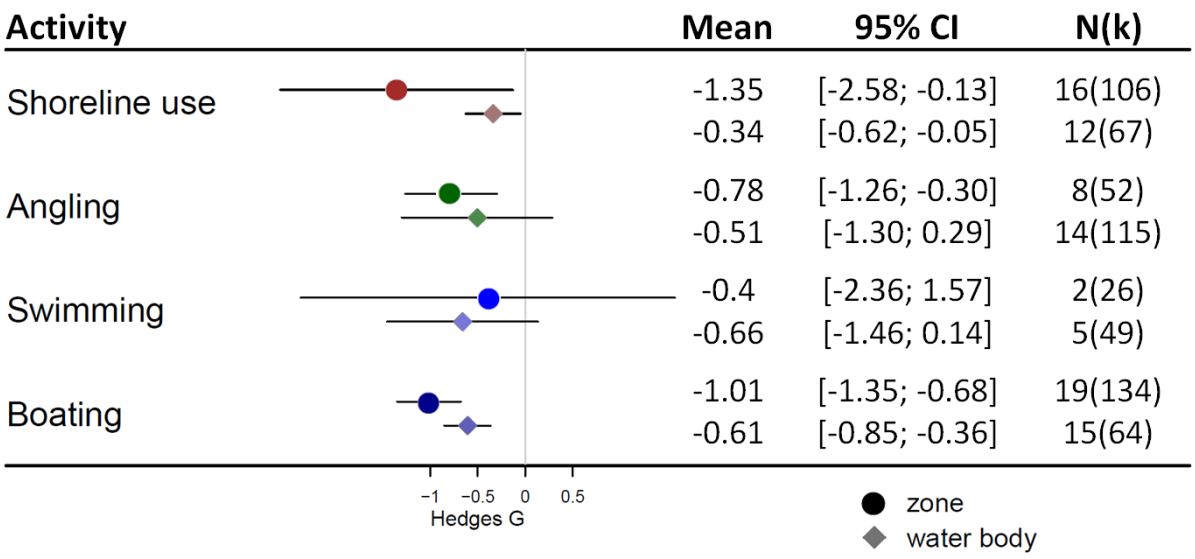

Figure S 4: Forest plot with comparison of mean effect sizes between studies comparison of whole water bodies (diamonds) and studies that compared zones within the same water body (circles) for each of the four recreational activities. Shown are the mean summary effect size (Mean), the 95% confidence interval (95% CI), number of Studies (N) and number of effect sizes (k). Effects are significant if the 95% CI (horizontal lines) does not overlap the vertical zero line.

Table S 3: Mean summary effect sizes for the four categories of recreational activities with 95% confidence interval (CI) number of studies (N) and number of individual effect sizes (k) weight either by inverse variance or by study validity. In addition the Q-statistics of moderator analysis of study validity and publication bias (Eggers regression test) and Fail save number (FSN) are shown with test for heterogeneity (QE) and test for moderator significance (QM). Heterogeneighty was observed in each model (QE with p< 0.01) and publication bias was present for each of our four recreational activity categories regardless of weighing by inverse variance or study validity. But Fail save number indicated that significant summary effect sizes were robust.

					Study quality		Publication bias		
Activities	**weights**	**Mean**	**CI**	**N(k)**	**QE**	**QM**	**QE**	**QM**	**FSN**
Shoreline use	inverse variance	-0.97	[-1.37 ; -0.56]	31(207)	764 (p < 0.01)	0.71 (p = 0.40)	682 (p < 0.01)	33.56 (**p < 0.01**)	49081 (> 1045)
Angling	inverse variance	-0.99	[-1.44 ; -0.54]	23(170)	4699 (p < 0.01)	2.85 (p = 0.09)*	4694 (p < 0.01)	43.80 (**p < 0.01**)	40967 (> 860)
Swimming	inverse variance	-0.67	[-1.11 ; -0.23]	8(115)	1594 (p < 0.01)	0.34 (p = 0.56)	1510 (p < 0.01)	42.43 (**p < 0.01**)	**89 (< 585)**
Boating	inverse variance	-0.61	[-0.78 ; -0.44]	36(209)	1248 (p < 0.01)	0.76 (p = 0.38)	1070 (p < 0.01)	110 (**p < 0.01**)	70511 (> 1055)
Shoreline use	study quality	-0.66	[-1.35 ; 0.02]	31(207)			682 (p < 0.01)	17.11 (**p < 0.01**)	49081 (> 1045)
Angling	study quality	-0.64	[-1.41 ; 0.13]	23(170)			4694 (p < 0.01)	6.52 (**p = 0.01**)	42167 (> 870)
Swimming	study quality	-0.42	[-1.05 ; 0.21]	8(115)			1510 (p < 0.01)	19.30 (**p < 0.01**)	**89 (> 585)**
Boating	study quality	-0.78	[-1.01 ; -0.56]	36(209)			1070 (p < 0.01)	7.79 (**p = 0.01**)	70511 (> 1055)

Table S 4: Result of moderator analysis for year of publication, publication type and peer review with number of studies (N) and number of individual effect sizes (k) weight either by inverse variance or by study validity and Q-statistics with test for heterogeneity (QE) and test for moderator significance (QM). Moderators did not significantly influence effect sizes despite peer review for studies about ecological impacts of angling with peer reviewed studies showing less negative effects than studies without peer review.

		Year of publication			Publication type			Peer reviewed		
	weights	**N(k)**	**QE**	**QM**	**N(k)**	**QE**	**QM**	**N(k)**	**QE**	**QM**
Shoreline use	inverse variance	31(207)	769 (p = 0.00)	2.82 (p = 0.09)*	31(207)	743 (p < 0.01)	0.67 (p = 0.71)	30(199)	759 (p = 0.00)	0.64 (p = 0.42)
Angling	inverse variance	23(170)	4704 (p = 0.00)	0.43 (p = 0.51)				20(135)	4526 (p = 0.00)	1.78 (p = 0.18)
Swimming	inverse variance	8(115)	1681 (p = 0.00)	0.24 (p = 0.62)						
Boating	inverse variance	36(209)	1244 (p = 0.00)	2.18 (p = 0.14)				36(209)	1247 (p = 0.00)	0.00 (p = 0.96)
Shoreline use	study quality	31(207)	769 (p = 0.00)	0.01 (p = 0.91)	31(207)	743 (p < 0.01)	0.41 (p = 0.81)	30(199)	759 (p = 0.00)	0.00 (p = 0.95)
Angling	study quality	23(170)	4704 (p = 0.00)	2.44 (p = 0.12)				20(135)	4526 (p = 0.00)	6.69 (**p = 0.01**)
Swimming	study quality	8(115)	1681 (p = 0.00)	0.20 (p = 0.65)						
Boating	study quality	36(209)	1244 (p = 0.00)	0.46 (p = 0.50)				36(209)	1247 (p = 0.00)	0.55 (p = 0.46)

Table S 5: Result of moderator analysis for year of publication, publication type and peer review with number of studies (N) and number of individual effect sizes (k) weight either by inverse variance or by study validity and Q-statistics with test for heterogeneity (QE) and test for moderator significance (QM). Level of biological organization as moderators did not significantly influence effect. Taxonomic group as moderator significantly influenced effect sizes of shoreline uses and boating.

		Levels of biological organization (categorical)			Levels of biological organization (continuous)			Taxa		
	weights	N(k)	QE	QM	N(k)	QE	QM	N(k)	QE	QM
Shoreline use	inverse variance	25(164)	599 (p < 0.01)	3.31 (p = 0.20)	25(164)	599 (p < 0.01)	3.19 (p = 0.07)*	31(207)	635 (p = 0.00)	56.09 (**p < 0.01**)
Angling	inverse variance	21(144)	4611 (p < 0.01)	0.05 (p = 0.98)	21(144)	4611 (p < 0.01)	0.00 (p = 0.99)	23(170)	4678 (p = 0.00)	8.15 (p = 0.23)
Swimming	inverse variance	7(111)	1486 (p < 0.01)	6.66 (p = 0.04)*	7(111)	1486 (p < 0.01)	4.48 (p = 0.03)*			
Boating	inverse variance	31(165)	1046 (p < 0.01)	3.85 (p = 0.15)	31(165)	1046 (p < 0.01)	0.05 (p = 0.83)	36(209)	1110 (p = 0.00)	10.91 (**p< 0.01**)
Shoreline use	study quality	25(164)	599 (p < 0.01)	2.68 (p = 0.24)	25(164)	599 (p < 0.01)	2.53 (p = 0.11)	31(207)	635 (p = 0.00)	64.2 (**p < 0.01**)
Angling	study quality	21(144)	4611 (p < 0.01)	1.36 (p = 0.51)	21(144)	4611 (p < 0.01)	0.84 (p = 036)	23(170)	4678 (p = 0.00)	6.06 (p = 0.42)
Swimming	study quality	7(111)	1486 (p < 0.01)	1.95 (p = 0.38)	7(111)	1486 (p < 0.01)	1.79 (p = 0.18)			
Boating	study quality	31(165)	1046 (p < 0.01)	1.62 (p = 0.44)	31(165)	1046 (p < 0.01)	1.60 (p = 0.44)	36(209)	1110 (p = 0.00)	22.71 (**p < 0.01**)

Table S 6: Result of moderator analysis for year of water body (lentic, lotic), habitat type and scale of studies (water body, zone) with number of studies (N) and number of individual effect sizes (k) weight either by inverse variance or by study validity and Q-statistics with test for heterogeneity (QE) and test for moderator significance (QM). Water body as moderator significantly influenced effect sizes of swimming uses. Habitat type as moderator significantly influenced effect sizes of angling, but only with inverse variance as weight for effect sizes. Scale as moderator did not influence effect sizes.

		Water body			Habitat			Scale (water body vs. zone)		
	weights	N(k)	QE	QM	N(k)	QE	QM	N(k)	QE	QM
Shoreline use	inverse variance	27(181)	661 (p < 0.01)	0.03 (p = 0.86)	20(131)	269 (p < 0.01)	2.61 (p = 0.76)	27(173)	623 (p < 0.01)	1.89 (p = 0.17)
Angling	inverse variance	20(166)	4562 (p < 0.01)	0.28 (p = 0.60)	8(79)	200 (p < 0.01)	15.55 (**p < 0.01**)	21(167)	4561 p < 0.01)	0.91 (p = 0.34)
Swimming	inverse variance	6(66)	199 (p < 0.01)	5.51 (**p = 0.02**)	8(115)			7(75)	282 (p < 0.01)	0.25 (p = 0.61)
Boating	inverse variance	36(209)	1225 (p < 0.01)	0.51 (p = 0.48)	32(158)	765 (p < 0.01)	0.99 (p = 0.80)	34(198)	1225 (p < 0.01)	0.38 (p = 0.54)
Shoreline use	study quality	27(181)	661 (p < 0.01)	0.07 (p = 0.79)	20(131)	269 (p < 0.01)	10.38 (p = 0.07)*	27(173)	623 (p < 0.01)	1.92 (p = 0.17)
Angling	study quality	20(166)	4562 (p < 0.01)	0.09 (p = 0.77)	8(79)	200 (p < 0.01)	3.74 (p = 0.15)	21(167)	4561 (p < 0.01)	0.53 (p = 0.47)
Swimming	study quality	6(66)	199 (p < 0.01)	3.55 (p = 0.06)*	8(115)			7(75)	282 (p < 0.01)	0.12 (p = 0.73)
Boating	study quality	36(209)	1225 (p < 0.01)	1.79 (p = 0.18)	32(158)	765 (p < 0.01)	6.64 (p = 0.08)*	34(198)	1225 (p < 0.01)	3.66 (p = 0.06)