

## Chapter 25

### Appendix. Economic Impacts of Marine Debris

Category- Resource Affected, Study, Location	Date-Sample size	Method/ Approach- Data	Findings: Estimated Effects/Losses
<u>Beaches-</u>			
<u>Beach cleaning:</u>			
NRC (1995) VA Beach, VA, USA	1993\$	Data contact	\$24,240/mi/yr (\$39,009/km/yr) €43,646/km/yr \$60,724/km/yr
NRC (1995) Atlantic City, NJ, USA	1993\$	Data contact	\$119,530/mi/yr (\$192,359/km/yr) €15,225/km/yr \$299,439/km/yr
Hall (2000): UK	1998£ n=69	Survey UK	77%bc, 897.1km, 10079.7tns, tc=£2,330,719/yr (n=36) £2598/km, €931/km €4.301mill/yr \$19.905mill/yr 157 x .931 x £64,742/munic.
Hall (2000): Denmark, Germany, Norway, Sweden	1998£ n=13	Survey KIMO members	84.6%bc, 3983km, 655tns, tc=£716,657/yr
Hall (2000): all countries	1998£ n=82	Survey UK, KIMO members	77%bc, 897.1km, 10079.7tns, tc=£2,913,795/yr
Mouat et al (2010): UK	2008€ n=61	Survey UK	93%bc, 839km, 21,757tns, tc= €1,513,189.28/yr (n=31) €379/km, €804/km, (tc=£3,964,152-2011) P= €17,936,000-18,780,000/yr, midpt=(P=€15.574mill/yr)
Mouat et al (2010): Belgium, Netherlands	2008€ n=12	Survey KIMO members	92%bc, 68.8km, 724tns, tc=€2,265,415.3/yr P=€10.4mill/yr
Mouat et al (2010): Denmark, Sweden, Ireland, Portugal, Spain	2008€ n=9	Survey KIMO members	100%bc, 210km, NA-tns, tc=€1,236,453/yr
Mouat et al (2010): all countries	2008€ n=82	Survey UK, KIMO members	95%bc, 1117.8km, 22,481tns, tc= €7,913,057.82/yr, (tc=£6,950,421-2011)
OSPAR (2009):all UK coast (from Environmental Agency, 2004)	2004£	Data contact	tc=£14mill/yr; 2011 values: £17.1mill/yr, €19.7mill/yr
OSPAR (2009): Skagerrak coast,	2006€	Data contact	tc=€1.5mill; 2011 value €1.87mill

Sweden

Naturvardsverket (2009): Poland 5 municipalities, 2 ports	NA, 2009€likely	Data contact	tc=€70,000; 2011 value €5,346,207		
Lane (2007): So. Africa To remove litter from waste stream	NA, 2007 likely	NA	cost to remove litter from wastewater stream= R2bill/yr (\$279mill/yr) (2011: \$303mill/yr, €218mill/yr)		
<u>Damage to Beach Use/Attendance:</u> ERA (1979) Beach closures, NY, NJ, USA MD washups	1976\$	3 beaches contacted	NY: Jones Beach, Robert Moses Beach: lost revenues= \$8.88mill/yr NY: Smith Point Beach: lost revenues=\$734,100/yr NJ: Seaside Heights, NJ lost revenues=\$332,100/yr, avoidance clean beach total= \$9,946,200/yr	€943,638/yr €28.261mill/yr	\$1,312,869/yr \$39.320mill/yr
NYDEC (1977), Swanson et al (1978) Beach closures from floatable MD, trash Washups, NY, USA	1976\$	City-State data	NY shore cleanup by Peace Corps=\$100,000; lost tourist revenue=\$15-25mill.	€43-71mill	\$59-98.9mill
NJDEP & USEPA (1987): NJ, USA Beach cleaning	1987\$	State data	NJ beaches cleaned, 127mi, 25,000cu yd, \$3mill/yr 204km, \$14,706/km,	€4.27mill/yr €20,930/km	\$5.9mill/yr \$29,119/km
Ofiara & Brown (1989,1999) Beach closures, NJ, USA MD washups & bacteria	1988 (1987\$)	Data contact	lost NEV: \$132-644mill, midpt=\$388mill lost revenues: \$251-1227mill, midpt=\$739mill Gross EV= \$383-1871mill	€45-2662mill	\$758-3704mill
Kahn et al (1989), WMI(1989), Swanson et al (1991) Beach closures, NY & NJ, USA	1988 (1987\$)	Data contact	lost NEV: \$447-1515mill, midpt=\$981mill lost revenues: \$539-2165mill, midpt=\$1352mill Gross EV= \$986-3689mill	€403-5236mill	\$1952-7286mill
<u>Losses to Tourism:</u> Balance et al (2000): S. Africa from decrease in beach cleanliness	NA, 2000 likely	NA	Decrease in beach cleanliness could decrease tourism revenue up to 52%		
OSPAR (2007): Sweden from MD on beach	NA, 2007€likely	NA	MD decreases tourism 1-5%/yr, loss revenues= £15mill/yr		
Ofiara & Brown (1989, 1999): NJ, USA MD washups, NJ beaches	1987 1988, 1987\$	Data contact Data contact	8.9%-18.7% decrease in beach attendance from MD washups in 1987, NJ 7.9%-32.9% decrease in beach attendance from MD washups in 1988, NJ	€45-2662mill	\$758-3704mill -see above
<u>Damages to Fishing:</u> Hall (2000): UK (Shetland Is Fisheries) Cost of MD removal fr nets, contaminated catch, damage to nets fr snagging	1998£ n=25	Survey	92% caught MD, 69% catch contaminated, 92% snag nets alv=£6,000-30,000/vessel, P=£885,400-4,428,000/yr alv: cMD=£4065/boat, cc=£1686/boat, sn=£3392/boat	€1.4-6.7mill/yr €8.308mill/yr	\$11.564mill/yr

Mouat et al (2010): UK (Shetland Is Fisheries) Cost of MD removal fr nets, contaminated catch, damage to nets fr snagging	2008€ n=22	Survey	86% caught MD, 82% catch contaminated, 95% snag nets, 82% fouled prop alv=€17,219-19,165/vessel, P=€1.7mill - 13mill/yr alv: cMD=€2,007/boat, cc=€183/boat, sn=€820/boat, fp=€182/boat	€9.7-10.8mill/yr €8.935mill/yr \$12.444mill/yr
Mouat et al (2010): Portugal, Spain	Portugal(n=21) Spain (n=6) 2008€ 2008€	Survey Survey	29% caught MD, 38% catch contaminate, 0-snag nets, 57% fouled propellers, 19% blocked intakes, ac=€2930/boat, 81% covered insurance 100% caught MD, 50% catch contaminate, 83.33% snag nets, 100% fouled propellers & blocked intakes	
MPMMG (2002): UK fishery	NA, 2002€ likely	NA	cost of MD removal=€33mill/yr	
Watson & Bryson (2003): Scotland Clyde fishery	2002\$	NA	avl=\$21,000 lost gear, \$38,000 lost time to single trap fisherman (per vessel, n=1)	
<u>Damage from Ghost Fishing:</u>				
NRC (2008): tangle & gillnet fishery, EU	2008€ likely	NA	loss=<5% of European Union commercial landings	
Brown et al (2005): Cantabrian Sea, Spain Monkfishery	2005€ likely	NA	loss=1.46% of landings, .0146(768)=11,213tns	
Allsopp et al (2006): US lobster fishery	2006\$ likely	NA	lost value of landings=\$250mill/yr	
Macfadyen et al (2009): Blue crab Fishery, LA, USA	2009 likely	NA	loss=4-10mill blue crabs/yr	
<u>Damages to Aquaculture:</u>				
Hall (2000): UK Shetland fishery	1998€ n=15	Survey	40% caught MD, 20% net contaminated, 1hr/mo=L80/mo some fouled propeller, ac=£150-1200/incident, (avg-ac=£675/incident) KIMO mthd: P=196x £675/incident, P=£132,300/yr	€73,683/yr \$212,222/yr
Mouat et al (2010): UK Scotland fishery	2008€ n=11	Survey	73% caught MD, N=268(.73)=196, al=€52.24/farm, P=€10,239/yr foul prop, N=196, al=€528.17/farm, P=€103,521/yr TotalP=€113,760/yr	€8491 \$11,824 €85,847/yr \$119,500/yr €94,338 \$131,374
<u>Damages to Shipping, Harbors/Marinas:</u>				
Hall (2000): UK Harbors, Marinas Removal of floatables and MD in harbor	1998€ n=42	Survey	31% cleanup MD, ac=£100-15,000, mean ac=£2354.67/hbr KIMO mthd: 300(.4615)=138, ac=£2354.67/hbr, P=138xac=£324,944/yr fouled propellers, 180incidents, ac=£3947/incident, P=£710,406/yr	€91,641/yr \$684,287/yr €1.075mill/yr \$1.496mill/yr
Mouat et al (2010): UK Harbors, Marinas Removal of floatables and MD in harbor	2008€ n=48	Survey	39.56% cleanup floatable MD, 6.59% dredge MD, 46.15% cleanup MD 69% reported fouled propellers, 28.6% report blocked intakes, no costs cleanup MD, ac=€8253/hbr, N=300(.4615), P=138x ac=€1,138,924/yr	€944,510/yr \$1.315mill/yr
Mouat et al (2010): Denmark, Norway, Portugal, Spain, all 2008€	Denmark (n=5) Norway (n=4)		80% cleanup floatables, 20% dredge MD, 60% fouled propellers, 20% blocked intakes, ac=€10,760.21/hbr 75% cleanup floatables, 25% dredge MD, 75% fouled propellers, ac=€10,052.07/hbr	

Removal of floatables & MD in harbor	Portugal (n=5) Spain (n=21)		20% cleanup floatables, 0-dredge, 69% fouled propellers, 20% blocked intakes 95% cleanup floatables, 0-dredge, 48% fouled propellers, 14% blocked intakes Spain tc=€63,917.33/yr (tc split as follows 97.38% - harbors, 2.62% - marinas)	
Kahn et al (1989), Swanson et al (1991) Damage to vessels (Commercial, Pleasure) NY, USA	1988 (1987\$)	Data contacts	MD floatables in NY Harbor	Commer. Boats: added repair costs= \$500mill Pleasure boats: lost NEV= \$26mill Gross EV= \$526mill €749mill \$1041mill
<u>Rescues-Vessels Disabled from MD:</u>				
Hall (2000): UK rescues	1998£	Log records	230rescues, ac=£4000/rescue, P=£506,000-1,334,000/yr	€765,579-2,018,345/yr, €1.392mill/yr \$1,065,566-2,809,221/yr, \$1.937mill/yr
Mouat et al (2010): UK rescues	2008€	Log records	286rescues from fouled prop in 2008, ac=€902-7653/incident N=286, P=€30,000-2,189,000/yr	€688,293-1.815mill/yr, €1.252mill/yr \$959,517-2.528mill/yr, \$1.743mill/yr
Moore (2008): US rescues	2005	Log records	269rescues; 116 injuries, 15 deaths, \$3mill property damages	
<u>Damage to Coastal Agriculture:</u>				
Hall (2000): UK (Shetland Is.)	1998£ n=30	Survey	96%MD in fences, 36%animals entangled in MD, 20% animals ingest-ill ac=£400/croft, N=1500crofts, P=£600,000/yr clear MD: 1440x £213/farm, animal entangle: 540x£10.5/farm, ill: 300x£30/farm (£321,390/yr)	€486,270/yr \$676,826/yr
Mouat et al (2010): UK (Shetland Is)	2008€ n=31	Survey	71.4%MD in fences, 41.9%animals entangled in MD or ingest-ill ac=€841.10/farm, N=25% of 1200crofts, P=€252,331/yr clear MD: 1200x .714x €840/farm=€719,712/yr, entangled 1200x .419x€17.663/farm=€8884/yr (TotalP=€728,596/yr)	€614,461/yr \$855,698/yr
<u>Damage to Coastal Power Plants:</u>				
Hall (2000): UK n=9	1998£	Survey	Clean corse, fine screens, 78% rpt seaweed/organic main prob, 11% rpt litter-£26,000 1 rpt 20-25% human litter (barrels of liquid, sewage, plastic bottles, general litter), <5% MD, tc=(.05)14,000=£700, 33% rpt must clean screens regardless of type of debris 11% MD problem, ac=(£26,000+700)/2=£13,350/yr, 33% rpt must clean regardless, hence ac=£0/yr	for 11%: ac=€20,199/yr, \$28,113/yr for 89%: ac=£0/yr
Mouat et al (2010): UK n=3	2008€	Survey	100% seaweed/organic main prob, 67% rpt some MD collected, tc=€16,516 (n=1) 1 rpt 5% is MD, 1 rpt 1% is MD, 1 rpt not affected; ac=1-5% (tc)= €165-826/yr 33% rpt must clean regardless of type of debris, hence ac=€0/yr	for 67%: ac=€137-685/yr, mean=€111/yr ac=\$191-954/yr, mean=\$573/yr for 33%: ac=€0/yr
<u>Damage from Invasive Species:</u>				
Naturvardsverket (2009): Black Sea Intro of American comb jellyfish	2009€likely	NA	intro of Amer. comb jellyfish caused collapse of anchovy fishery in Black Sea, €240mill/yr	
Holt (2009): Wales, UK	2009£ likely	NA	control & eradication of invasive species, Carpet sea squirt over 2009-2019=£525,000	

Holyhead Harbour

cost of inaction=up to £6.876mill 10-yr period

Notes: Data contact refers to data obtained from authoritative agencies, USEPA, US Coast Guard, state/municipal/beach park data and/or representative-officials responsible.

Abbreviations where not obvious: MD=marine debris, mill.=million, bc=beach clean, ac=average cost, tc=total cost, P=projection, munic=municipality or local authority, avl=average loss per vessel, hbr=harbor, al=average loss, N=universe projections based on, Nbc=no. municipalities beach cleaned for projections, TotalP=total projection, midpt=midpoint, NEV=net economic value, EV=economic value. Totals may not add due to rounding. Mouat et al is abbreviated as KIMO in places for shorthand. One date appears if the study date and year of monetary value were the same, a monetary symbol appears after the date.

All conversions: 1987\$ to 2011\$: 1.9801 from US CPI-U, 1976\$ to 2011\$: 3.9532 using US CPI-U, 1998£ to 2011£: 1.3128 from UK CPI, 2011\$ to 2011€ .71876 exchange rate, 2011£ to 2011€ 1.1525 exchange rate, 2011£ to 2011\$: 1.6041 exchange rate, 2011€ to 2011\$: 1.3926 exchange rate, 1993\$ to 2011\$: 1.5567 from US CPI-U, 1998€ to 2011€ 0.8293 using historical inflation rates for €currency.