Economic assessment of market & non-market damages of oil spills

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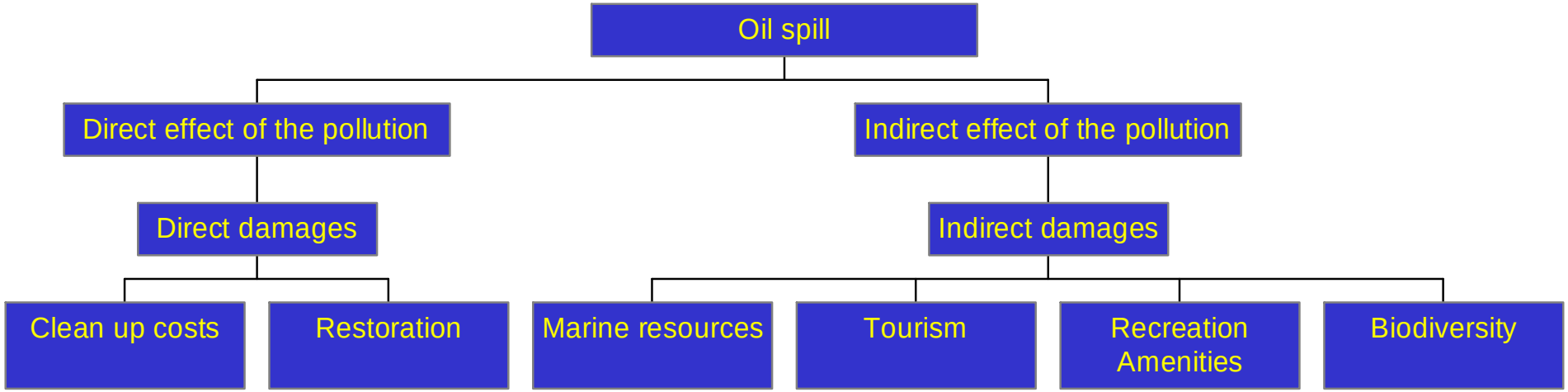
Total damages



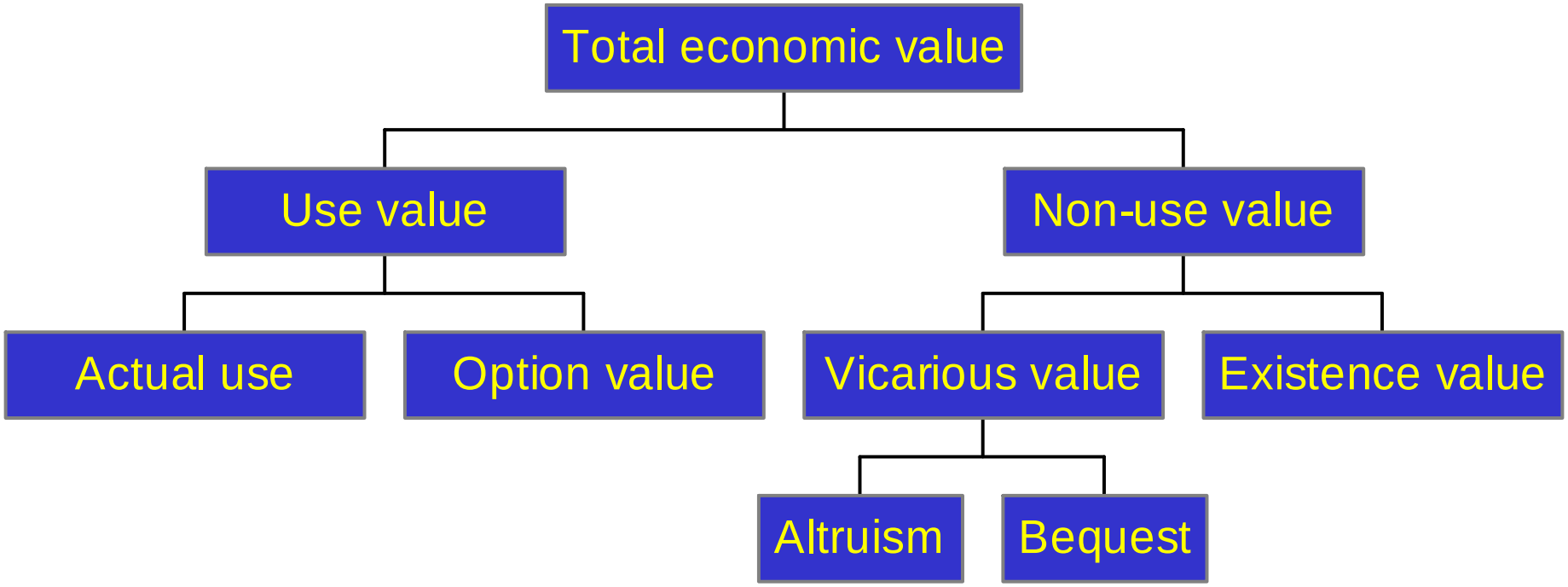
Economic value of a coastal area (1)

Type of service	Source	Market
Transport Industry	Ports Infrastructures	Yes
Housing	Marine features	Yes
Tourism	Marine features	Yes
Fishing	Fish, shellfish…	Yes
Aquaculture	Oysters, mussels	Yes

Economic value of a coastal area (2)

Type of service	Source	Market
Sailing Boating	Open sea	Yes/No
Fishing Sun bathing Swimming	Fish, shellfish… Beaches Open sea	No
Walking Nature watching Picnicking	Footpaths Natural beauty Heritage	No
Flora, fauna	Habitats	No

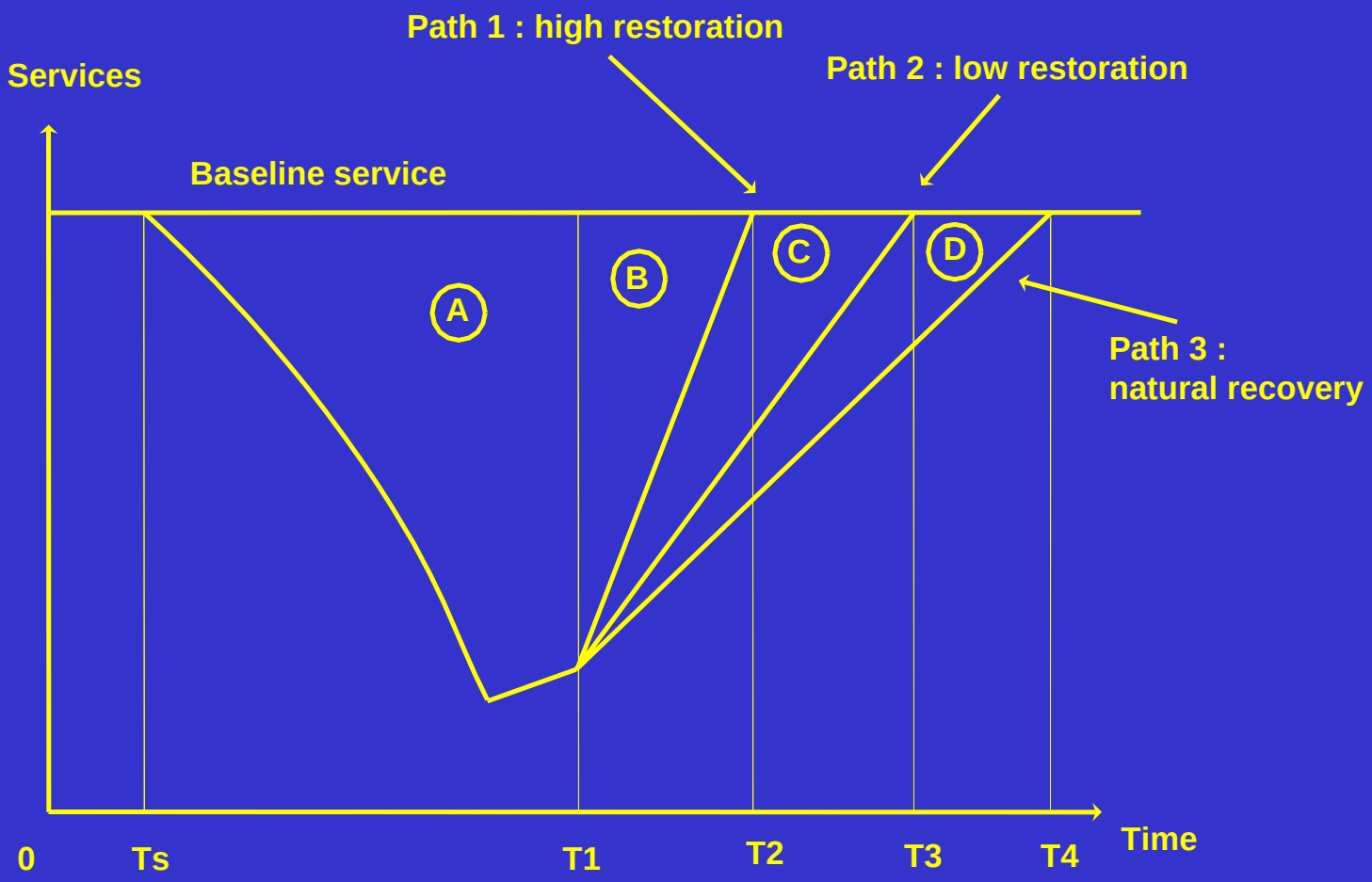
Definition of total economic value



Comments on total economic value

- Intrinsic value is often regarded as being a value that resides ‘in’ environmental assets, but which is independent of human preferences
- Total economic value is a purely utilitarian concept & does not encompass intrinsic values
- However a number of motives including ‘a right to exist’ for the asset in question (e.g. a living creature) may influence preferences

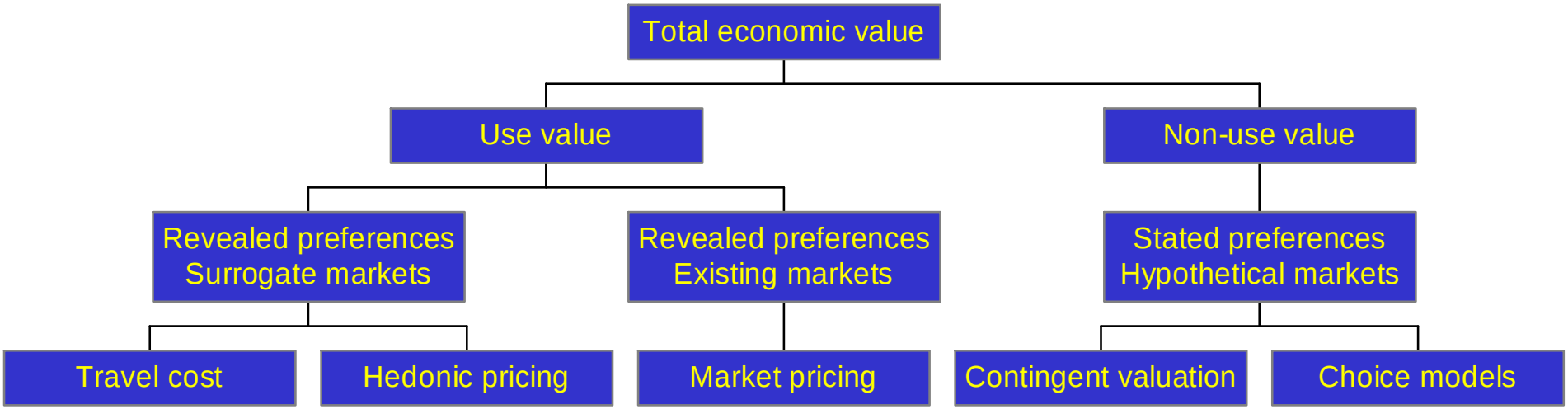
Loss of natural resource services



Options for cleaning & restoration

- Don’t waste money & rely on waves and tide efficiency, chemical substances threaten marine life
- Favour full restoration asap to minimise the profit foregone
- Trade-off between clean-up expenditures & losses
- Marginal productivity of cleaning operations?

Estimation of total economic value



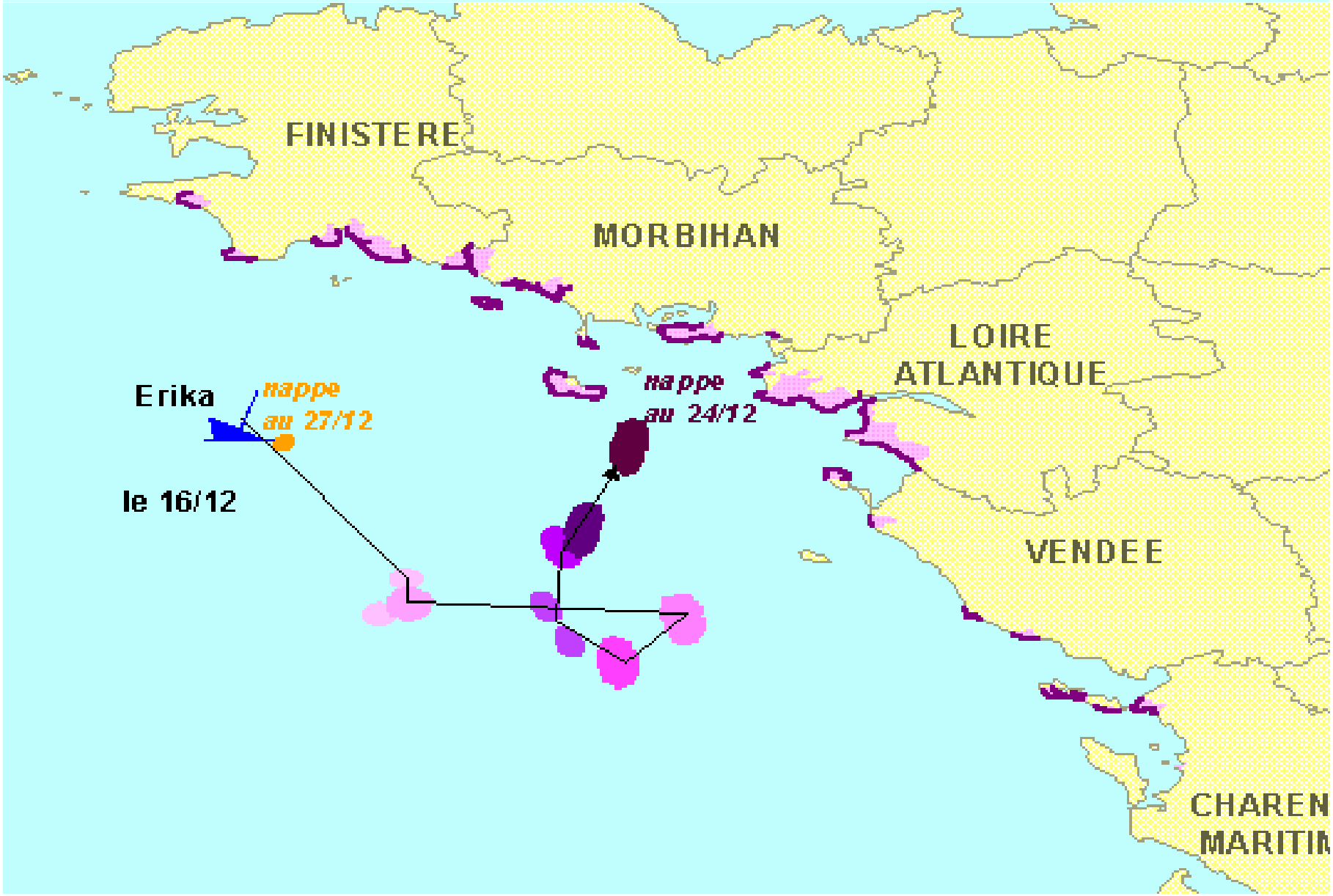
Overview of revealed preference methods

Method	Revealed behaviour	Conceptual framework	Type of application
Hedonic pricing	Property purchased	Demand for differentiated products	Property value
Travel cost	Participation in recreation activity	Complementarity goods	Recreational demand

The *Erika* case

- On December 16, 1999, the tanker *Erika* was ruptured off the South coast of Brittany
- Over the next six months,
- This spill resulted in physical injury along 400 km of a coast line
- Including valuable spots for recreation & fishing on foot which is popular in Winter & Spring among the resident population

Shoreline impacted by the *Erika* oil spill



Direct damages

- Clean-up and restoration costs
  - Actual expenditures (invoices),
  - Discussion on the opportunity cost for draftees, the army, volunteers & politicians
- Restoration programmes
- Cleanup & restoration
  - 124 million € (Oct. 2000)

Tourist trade (Summer 2000)

Atlantic coastal area	Impacted area	Non-impacted area
Non-market accommodation	- 6.4 %	4.3 %
Market accommodation	- 1.7 %	- 1.9 %

Indirect damages: market component

- Marine activities : business accounts, statistics related to catches per specie, data on fishing effort
- National level: oysters (-30%), fresh fish (- 7%) January-February 2000
- More severe decrease in the wholesale market of the impacted area (both in volume & price)
- Tourist industry losses: business accounts, aggregate data on wages per activity and use of technical coefficients
- Total damages have been estimated to 914 million € by a consulting firm
- Over-estimation (total sales, underlying logic)
- That only includes commercial losses suffered by the tourist industry & marine activities
- Losses of the whole economy: I O Table

Indirect damages: non-market component

- Recreation and amenity losses of residents
  - Survey to describe trouble & change in marine-based activities
  - Survey of physicians & chemists (public health impacts?)
- Recreation and amenity losses of tourists
  - Tourists who did come
  - Tourists who gave-up
- Combination of methods
  - Travel cost
  - Contingent valuation
  - Transfer

Recreation & amenity losses of residents

- Outdoor recreational activity with emphasis on fishing on foot
- Use of available information on fishing on foot
- Need of *ex post* information in order to estimate the change in fishing due to the oil spill

Available information on fishing on foot

- On-site survey along the coast of Brittany before the spill (n=501)
- Motivations, visit rate, distance travelled, attitude related to travel time
- Personal attitude towards food safety, personal experience with a shellfish poisoning

Consumer's surplus per visit

- Individual travel cost Explanatory variables: travel cost, income with a threshold, dummies
- Values are relatively high & comparable to those obtained for salmon & sea trout angling
- But specific features deserve attention: no licence fees, equipment negligible & yearly number of visits is much smaller
- Annual surplus is significantly lesser than for salmon & sea trout

Fishing on foot (surplus / visit)

Area	€
North	68.8
West	52.6
South	48.3
Total	54.9 – 56.4

Ex post surveys

- 500 face-to-face interviews of members of a union of recreational fishermen
- 2128 phone interviews (692 respondents fish on foot)
- 3 coastal zones plus Nantes (located inland)
- Random samples
- Members of the union
- Phone directory

Participation in fishing on foot (phone survey)

	Total population	Number of interviews	Number of fishermen	Fishermen (%)
Zone 1	411 188	655	164	25.0
Zone 2	205 687	646	239	37.0
Zone 3	357 327	582	195	33.5
Nantes	544 932	245	94	38.4
Total	1 519 134	2 128	692	32.5

Participation model

- $P(x)$ = probability to fish
- Logit model
- $Ln\{P(x) / [1 - P(x)]\} = \alpha - \beta x + \gamma f(z)$
- x = distance
- z = individual characteristics

Assessment of baseline participation

- Participation rate in fishing on foot was high as it concerns one-third of the population
- Visit rate (fishing effort) decreases with the distance travelled
- Conservative estimate of the number of visits for a six-month period is 2.8 million

Decrease in fishing on foot

- 75% gave up on the shoreline and 45% in Nantes
- Among those who stopped fishing, 75% have substituted an other outdoor recreational activity (mainly walking, some boating and sailing)
- Other people continued to fish on foot in the same places (despite prohibition) & only 18% reported a decrease in fishing effort
- Most people gave up fishing because WTP for self-protection is to small to drive to a safer place
- In a pollution limited to a single spot, people would have behave differently

Number of lost visits (in million)

	Coastal area	Nantes area	Total
Give up & no substitute	0.405	0.072	0.477
Give up with substitute	1.217	0.216	1.433
Total	1.622	0.288	1.910

Amenity losses & value transfer

- Only the change in recreational patterns was estimated (face-to-face & phone interviews)
- Unitary values come from other sources
- For those who gave up fishing with no substitution, damage per visit equals surplus
- For those who gave up fishing with a substitution , damage per visit equals the difference in surplus between activities
- For the others, only those who decreased their visit rate suffered a damage,which is neglected

Damage assessment (amenity losses)

People's behaviour	Lost visits (10^6)	Unitary values (€)	Total damages (10^6 €)
Stop fishing & no substitute	0.477	54.9	26.2
Stop fishing with a substitute	1.433	50.3	72.1
Continue & no change	0	0	0
Continue with a drop	?	?	?
Total	1.910		98.3

Comments on residents' losses

- Orphan losses account for a comparable amount than the cleaning & restoration expenditures
- Around 100 million € *vs.*. 124 for the land-based component of the clean-up operations
- It confirms the significance of recreational & amenity losses (see *Amoco Cadiz*)
- But only torts supported by relevant accounts can be repaired
- Regarding the compensation doctrine, can we imagine an evolution of these orphan losses?

Value of an ecosystem

- Ecosystems are so important that without them human & other life would not exist
- The economic issue is one of measuring what is being lost when parts of a given ecosystem is lost or degraded
- The central problem is one of uncertainty: the basic fact is that we do not know what these losses are likely to be
- It is widely argued that the amount of biomass depends on diversity and that the resilience to shocks & stresses also depends on diversity

Ecological losses (1)

- What should be counted as ecological losses & how should it be measured?
- Empirical evidence: loss of biomass
- Naïve procedure: arbitrary unitary price per kg of lost biomass (e.g. price paid by labs)
- The mortality of lower-trophic-level organisms creates an ecological imbalance, which likely leads to economic damages

Ecological losses (2)

Level 0 *Producers*	Phytoplankton *Potential production*	
Level 1 *Herbivores*	Zooplankton *Non-commercial output*	Herbivorous fish *Commercial output*
Level 2 *Primary carnivores*	Carnivores 1 *Non-commercial output*	Fish 1 & crustaceans *Commercial output*
Level 3 *Secondary carnivores*	Fish 2 *Commercial output*	

Ecological losses (3)

- Food chain approach
  - Transformation coefficients (see literature)
  - Structure of commercial output (see landings)
  - Market price (with an adjustment)
- Willingness-to-pay approach
  - Restoration programme (revealed preferences)
  - Stated preferences
  - Lexicographic preferences

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