

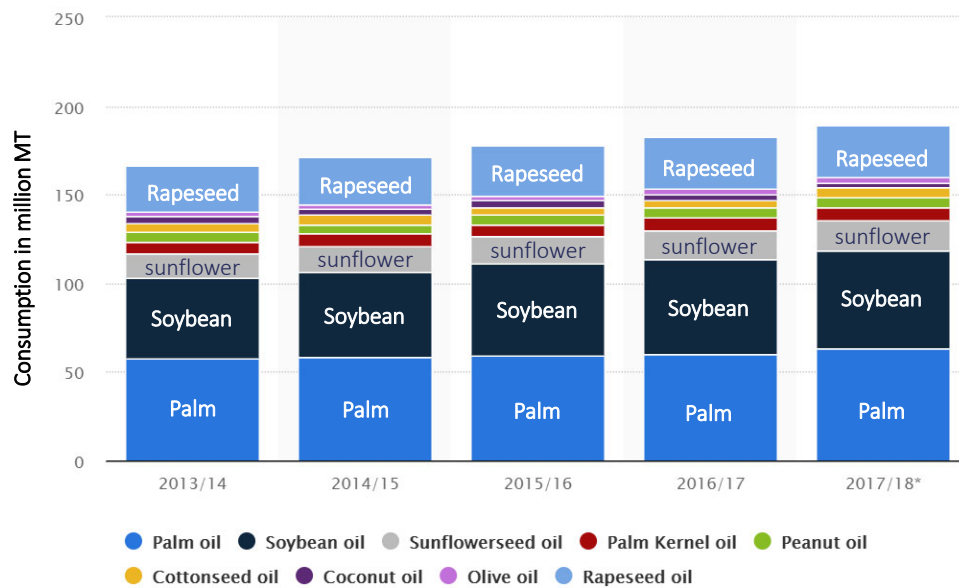


Vegetable Oil Matters

Dr Ann S. Zhang
Technical Adviser



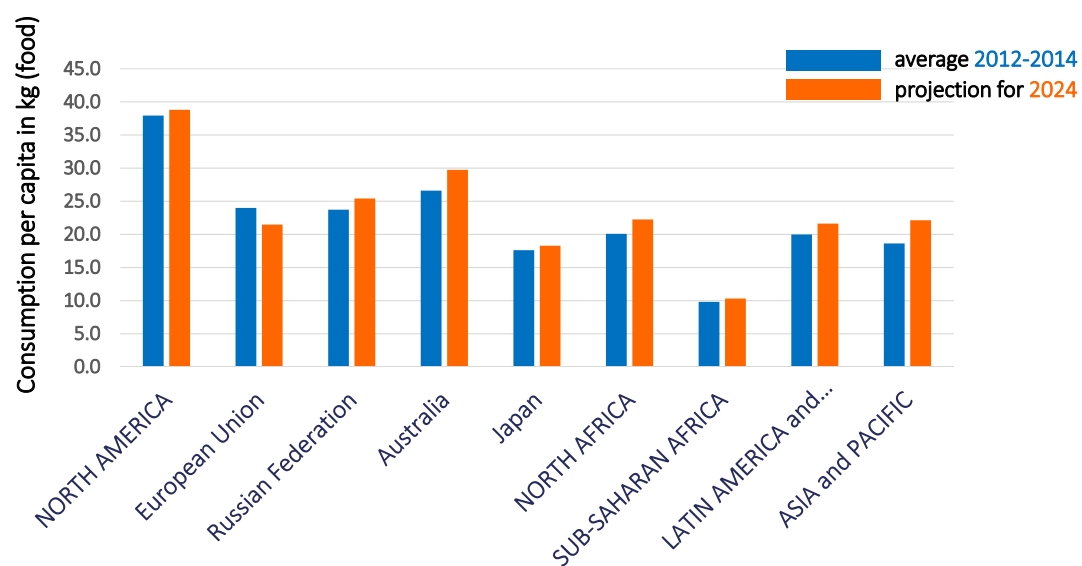
Vegetable oil – consumption and transportation



Source: statista.com



Vegetable oil – consumption and transportation



Source: OECD – FAO Vegetable oil projection



Vegetable oil – shipping

2010 HNS Convention (not yet in force)

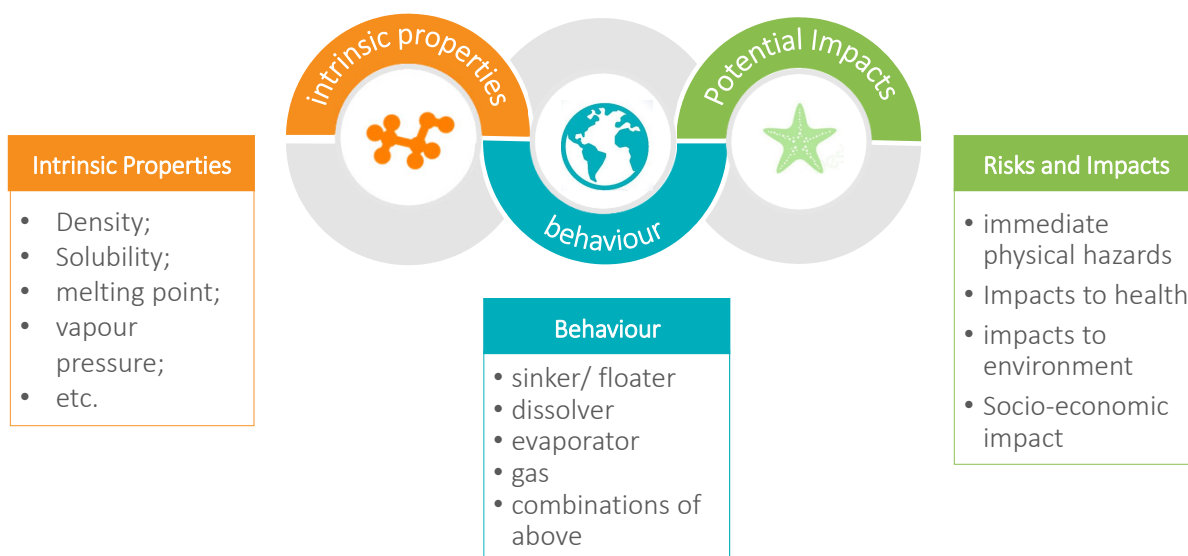
Shipping Name	UN No	Transport Mode	Contributions			HNS Classification						
			contributing	Account	Sector	I	II	III	IV	V	VI	VII
Palm oil		Bulk	Y	General	Other HNS	Y	Y					
Soybean oil		Bulk	Y	General	Other HNS	Y	Y					
Sunflower seed oil		Bulk	Y	General	Other HNS	Y	Y					
Groundnut oil		Bulk	Y	General	Other HNS	Y	Y					
Cotton seed oil		Bulk	Y	General	Other HNS	Y	Y					
Coconut oil		Bulk	Y	General	Other HNS	Y	Y					
Olive oil		Bulk	Y	General	Other HNS	Y	Y					
Rapeseed oil		Bulk	Y	General	Other HNS	Y	Y					

MARPOL Annex II – Noxious liquid
IBC Code – Dangerous liquid carried in bulk

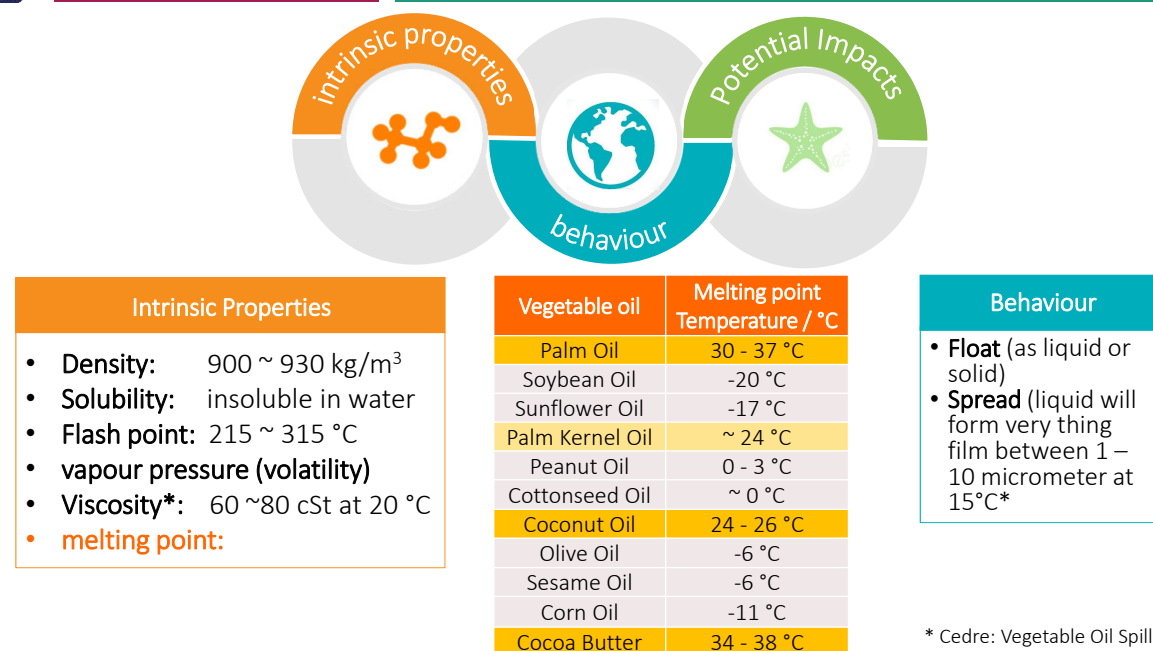
Source: <http://www.hnsconvention.org/hns-finder/>



Risk assessment



Risk assessment



* Cedre: Vegetable Oil Spills At Sea



Risk assessment – potential impacts to marine environment, human health and amenity

GESAMP Hazard Profile May 2017	Aquatic Environment (score: 0 - 6)				Human Health (Score: 0 - 4)						Interference with other uses of the sea		
	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3 (0 - 3)
Product	bio-accumulation	bio-degradation	acute toxicity	chronic toxicity	oral toxicity	dermal toxicity	inhalation toxicity	to skin	to eye	long-term health	tainting	wildlife & benthic	coastal amenities
Palm oil	0	R	0	NI	0	(0)	(0)	0	0			Fp	2
Soybean oil	0	R	0	NI	0	(0)	(1)	(0)	1			Fp	2
Sunflower oil	0	R	0	NI	(0)	(0)	(1)	(0)	(1)			Fp	2
Cotton seed oil	0	R	(2)	NI	(0)	(0)	(1)	0	1			Fp	2
Coconut oil	0	R	1	NI	0	(0)	(1)	0	(1)			Fp	2
Olive oil	0	R	(2)	NI	(0)	(0)	(1)	1	1			Fp	2
Rapeseed oil	0	R	(2)	NI	(0)	(0)	(0)	(1)	(1)			Fp	2

- No concerns over bioaccumulation;
- Readily biodegradable
- No confirmed chronic toxicity
- No or low acute toxicity

- No acute mammalian toxicity (bracket of C3 valued in vapour form)
- No known long-term health concerns;
- May be mildly irritant to eye and skin in direct contact

- Exists as persistent floater at sea;
- Moderately affect coastal amenities, possibly lead to the closure of amenity



Risk assessment – potential impacts to marine environment, human health and amenity

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Sunflower oil	0	R	0	NI	(0)	(0)	(1)	(0)	(1)			Fp	2
Cotton seed oil	0	R	(2)	NI	(0)	(0)	(1)	0	1			Fp	2
Coconut oil	0	R	1	NI	0	(0)	(1)	0	(1)			Fp	2
Olive oil	0	R	(2)	NI	(0)	(0)	(1)	1	1			Fp	2
Rapeseed oil	0	R	(2)	NI	(0)	(0)	(0)	(1)	(1)			Fp	2

Impacts of Vegetable Oils Spills

- Large slick at sea could affect surface dwelling organisms, result in smothering, coating fur and feathers, suffocation through oxygen depletion, starvation etc.
- Large accumulation on shoreline may result in rancid odours during degradation (depending on the properties of oil), affect water intake, and affect amenity use

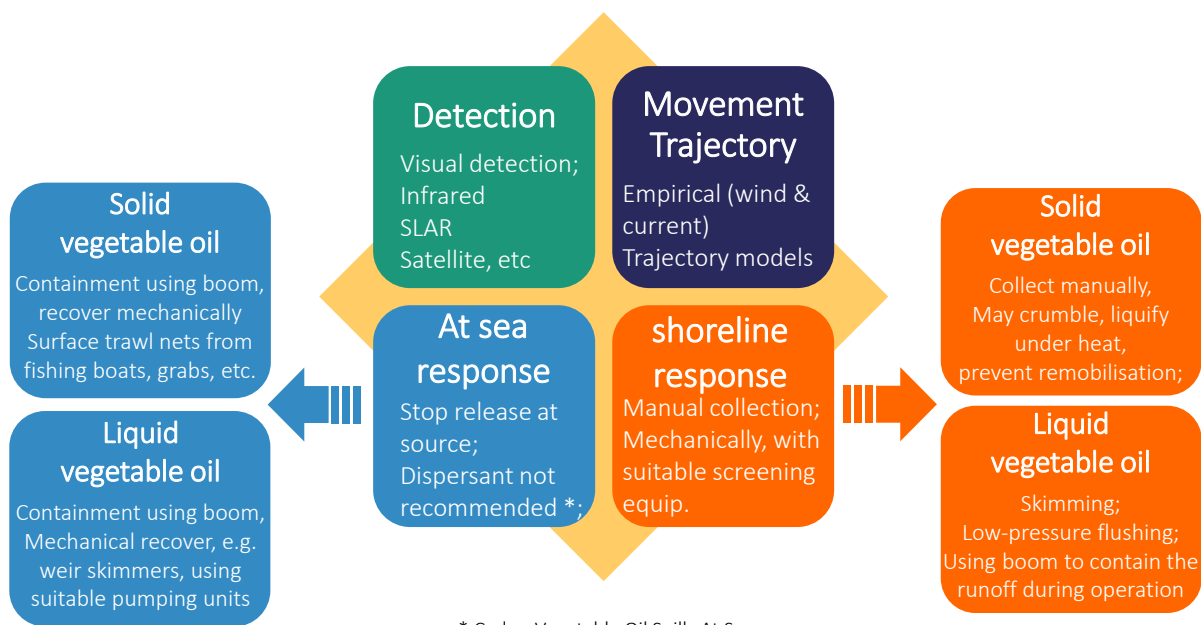
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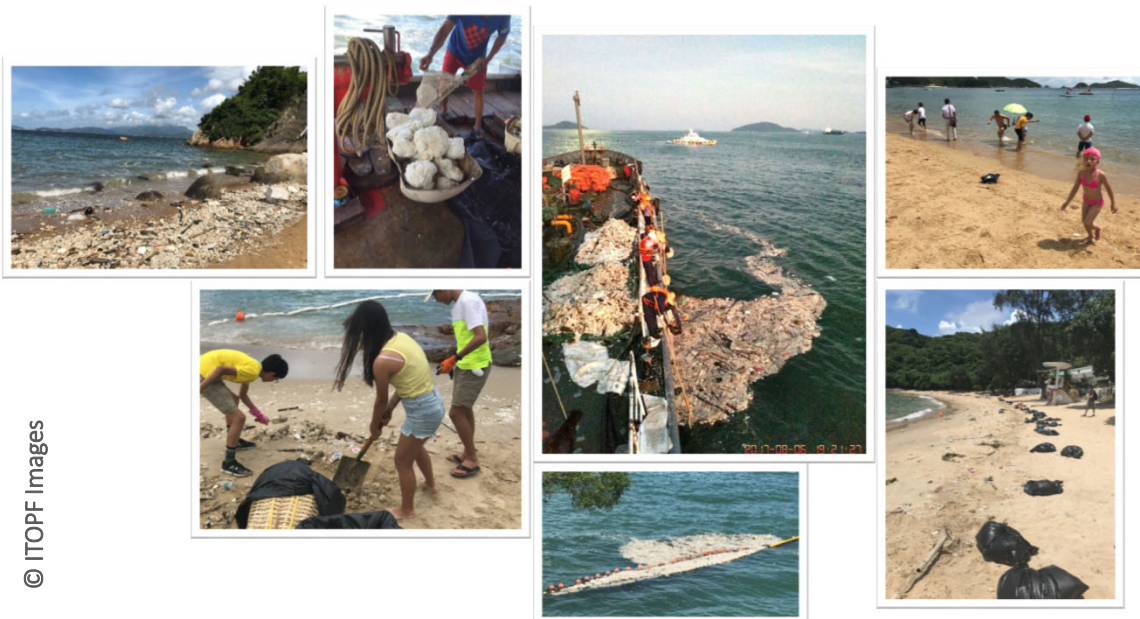
Response Options



* Cedre: Vegetable Oil Spills At Sea



Case Study – a palm stearin spill



© ITOPF Images



Case Study – a palm stearin spill



Case Study – risk assessment in practice

Refined, bleached, deodorised palm stearin

NAME	UN NO.	TRANSPORT MODE	CONTRIBUTIONS			HNS CLASSIFICATION						
			CONTRIBUTING	ACCOUNT	SECTOR	I	II	III	IV	V	VI	VII
PALM STEARIN		Bulk	✓	General	Other HNS		✓	✓				



Palm stearin transported in heated tank (about 60°C)

15 min



solidifies at 30°C ambient temperature

- Melting point ~ 44 - 56°C ➡ exists as **solid** after release
- Specific gravity 880 kg/m³ ➡ **floaters**
- Main components: triglycerides of fatty acids ➡ **not soluble** in water
- Low plasticity (partial crystallised) ➡ does **not aggregate** together
- **GESAMP Hazard profile**
 - no acute or chronic aquatic toxicity
 - no bio-concentration effect
 - no acute oral / dermal / inhalation toxicity to mammal
 - not irritating to skin or eye
 - no specific health concern
 - **may interfere with wildlife**
- readily **biodegradable**, **however** may affect coastal amenity use



Case Study – behaviour at sea



Day 2 - morning

plates / lumps up to 60cm in relatively concentrated area



Day 2 – afternoon

gradually broke into small pieces, formed belt / small slick under the influence of dominant current & wind

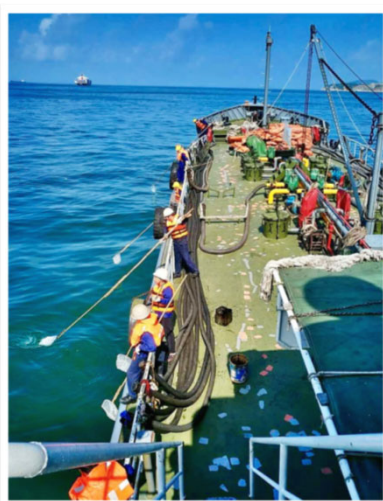


Day 3 – morning

Further scattered across wide area (200 – 300 km²), broke into tiny pieces (pea / rice), increasingly difficult to recover at sea



Case Study – at-sea response





Case Study – shoreline response



Case Study – shoreline response



- Shoreline clean-up was relatively straightforward;
- Regular press releases provided by the government, updating the public on the environmental monitoring results, clean-up progress, etc.
- Waste disposal was easier than other contaminants - about half of the solid waste collected from shoreline was turned into biodiesel;



Other scenarios



photo courtesy (top-right): Elastec Inc.



Vegetable Oil Matters

Contents

- Consumption and Transportation
- Physiochemical properties of vegetable oils
- Behaviour, Fate, and Potential Impacts
- Response options
- Case Study



Thank you for your attention!

Dr Ann S. Zhang
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