Epidemiology and Cyanobacteria

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UNIVERSITY OF EXETER | MEDICAL SCHOOL
European Centre for Environment & Human Health
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Exposure

- Marine
  - Recreational
  - Residential
  - Aerosol
  - Food (shellfish, mammals?, reptiles?
- Freshwater
  - Recreational
  - Potable

Outcomes

- Oral consumption
  - Hepato
  - Neuro
- Respiratory
  - Red tide
- Dermal
  - Freshwater
  - Marine

Symptoms

- Gastrointestinal, vomiting, diarrhoea
- Headache
- Coughing
- Skin itch
- Non-preceise
- Rarely leads to hospitalisation

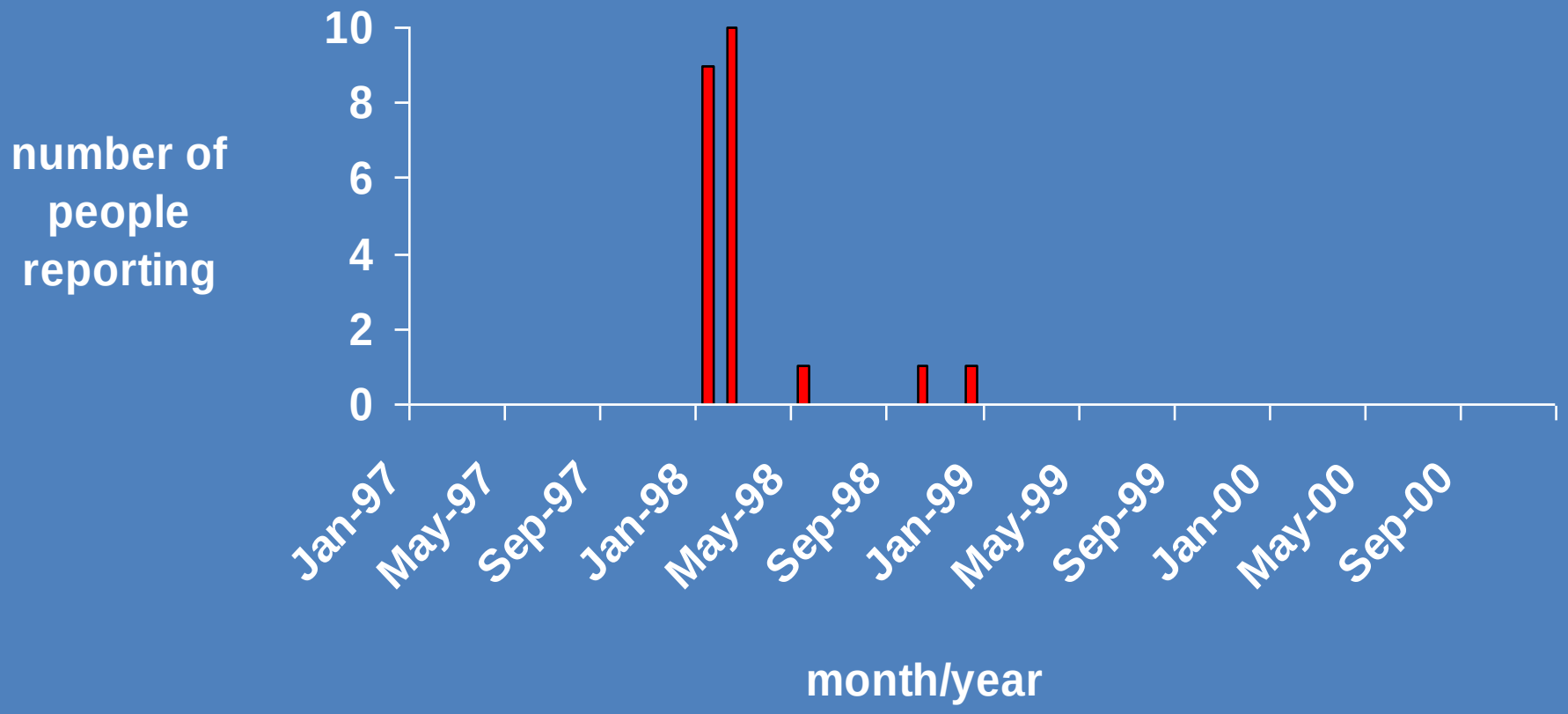
Exposure

- How do you get a measure of how much people come into contact with cyano
- Bathing
- Drinking
- Breathing
- Eating (shellfish or “lehmu”)

Ecological

- Analysis of population rather than individual
- Ecological fallacy
  - inferences about the nature of individuals are deduced from inference for the group to which those individuals belong

Incidence of Dermatitis 1997-2001



Case control

- Compare exposures between those with symptoms
- Retrospective questions on exposure
- Relies on peoples memories

Cross-Sectional Study

- Look at exposures and outcomes at single point in time
- Don’t know if symptom of exposure came first

Prospective studies

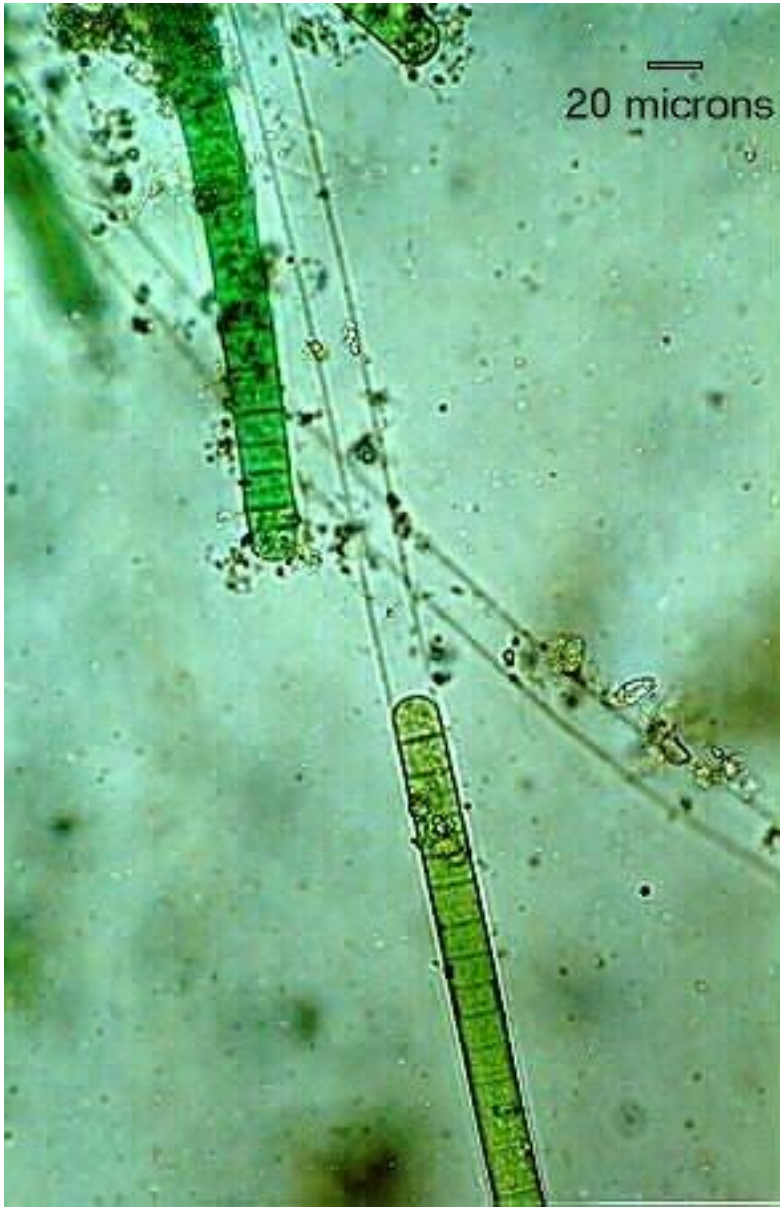
- Assess cohort (sub-population) prior to exposure
- See who gets symptoms
- Expensive
- Risky if rare event

Lyngbya majuscula

- marine cyanobacterium
- fine strands 10-30cm length
- drab olive-coloured matted mass
- photosynthetic & N fixing
- 40sqkm blooms
- 450 ton cleared from beach
- dissappears rapidly

WARNING
Blue Green Algae Bloom
The blue-green algae, Lyngbya,
has been detected in the water and
on the foreshore of the area.
Contact with Lyngbya can cause skin,
eye or respiratory irritation.
Swimming and wading in this area
is not recommended.
Avoid contact with any material on the beach.
For further information,
contact Caboolture Shire Council on
5420 0100

25 µm


20 microns

Distribution

- estuarine and coastal waters
- benthic
- tropical and subtropical
- inter-tidal zone to 30m
- Hawaii, Guam, Mozambique, Curaçao
- Magnetic Is, Fraser Is, Moreton Bay, WA

Distribution of *L. majuscula*

LATE CITY

The Courier-Mail

Thursday November 22, 2001 $1.00

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Toxic rivers poison bay

Siobhain Ryan

A FLOOD of sewage, sediment and chemicals is damaging southeast Queensland waterways and threatening the area's drinking water.

A damning government-funded report says fish and other species in the food chain are soaking up sewage released into rivers from the Sunshine Coast southwards.

The report blames the region's population and development boom for carving away at the bush and increasing stress on rivers and bays.

The draft State of the South East Queensland Waterways Report 2001 says that in parts of the Maroochy River, all aquatic life carries a "distinct sewage signal" in their tissues".

In the nearby Mooloolah River, oysters showed traces of lead as well as "highly elevated concentrations of copper" that rivalled results from pollution hot spots overseas.

Even major water storages had been affected. Fish from the Wivenhoe Dam had high levels of mercury, chromium, copper, zinc, nickel and lead in their tissue, "possibly as a result of deposition of contaminated sediments from the upper Brisbane River".

University of Queensland associate professor in marine biology Bill Dennison, who helped edit the report, said toxic material was now a fact of life in the waterways.

He said that while it was still safe to eat the seafood, the higher toxic load pointed to the need for greater vigilance.

The report, to be released next year, shows the size of Moreton Bay's seafood catch is dwindling. In the past four years, commercial fishing boats have spent more time on the water for a 30 per cent lower return.

Another risk to catches, and the health of fishermen, was blue green algae known as fireweed or lyngbya.

Dr Dennison said the toxic algae remained the "cancer of the bay", threatening marine life and posing a danger to people. In 1999, 130 fishermen and 1500 swimmers reported health problems from lyngbya exposure, including breathing difficulties and skin and eye irritations.

Less toxic algal blooms also occurred at freshwater sites, often starting at sewage plant discharge points.

Sewage plumes from some of the 69 major sewage plants extended up to 30km from their source in summer.

The report found that the impact of more than 360,000 people in unsewered areas of southeast Queensland is being felt downstream because of poorly sited or maintained septic tanks.

One government study of the Cedar Creek area north-west of Brisbane, shows that 30 per cent of septic systems do not function properly.

Faecal coliform, total nitrogen and total phosphorus regularly exceed national water quality guidelines in the waterway, which is rated "one of the healthiest and least impacted" creeks in Pine Rivers Shire.

Animal waste has also rendered parts of Logan and Albert Rivers periodically unsafe for swimming.

And 5 per cent of beach sites surveyed breach water quality standards for recreational use.

The report says the banned pesticide dieldrin, related to DDT, has been found in river sediments in the Logan, Albert, Pimpama, Coomera and Maroochy rivers.

Continued Page 2

Squads to curb hospital attacks

Malcolm Cole

STATE hospitals will tag potentially aggressive patients and devising anti-violence squads to curb attacks on nurses and medical staff.

A State Government occupational violence strategy says long waiting times, dissatisfaction with service and access to drugs are placing hospital workers at increasing risk of violent attack.

While the draft report identifies "an increase in the incidence of occupational violence", the Government admits it has no statistics on attacks against nurses and is not able to report on the extent of the problem.

Queensland Nurses Union spokeswoman Amanda Richards said attacks on medical staff were increasing in both number and intensity.

"A month or six weeks ago it was really getting quite severe," Ms Richards said. "People were ringing up and saying they'd had enough of the violence. People were really quite scared."

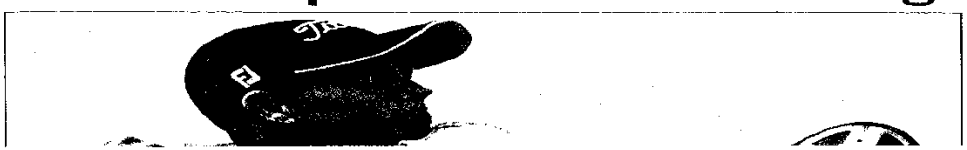
She said threats against staff were becoming more personal. "It's now I know

Bin Laden tells aides to kill him if cornered

THE US does not expect to take terror leader Osama bin Laden alive after it was revealed he had ordered aides to kill him if cornered.

Bin Laden's orders were carried in the Saudi daily newspaper al-Watan which said the death wish had been revealed by Taliban defectors to the CIA.

Jet skis on par with clubs for rising champ



Bernie Pramberg

GOLD Coast golfer Adam Scott wants to achieve two goals before swapping his clubs for a jet ski during the holiday season.

Scott, 21, touted as a future major championship winner by Greg Norman, is out to win the $1.2 million Holden Australian Open starting at The Grand on the Gold Coast today. And he should improve his world ranking from 97th to inside the top 50 with a strong performance.

"The Open is being held in

Haddrill 1999

Haddrill 1999

Pumicestone Catchment Group 1997

Pumicestone Catchment Group 1997

Intoxication with *Lyngbya*

- oral and g-i inflammation
- eye and respiratory irritation
- tumour promoter (chronic exposure)

- rabbitfish intoxication
- consumption seaweeds (3 fatalities)
- fatality after consumption turtle meat
- LC/MS identified lyngbyatoxin A

Comparative toxicity (ip-mouse)

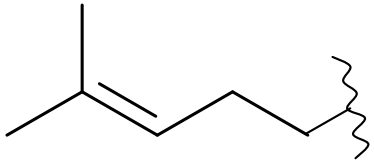
		mg/kg
Anatoxin-a(s)	0.02	
Nodularin		0.05
Lyngbya: DAT		0.15
Lyngbya: LA	0.30	
Strychnine		0.98
Arsenic		40.0
Botulinum toxin A	160	

Pattern of Dermatitis

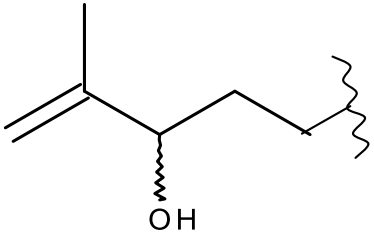
- swimming in water turbid with “seaweed”
- continued wearing of swimsuit
- gradual onset of itching and burning
- redness, blistering 3-8 hours after

Lyngbyatoxin A

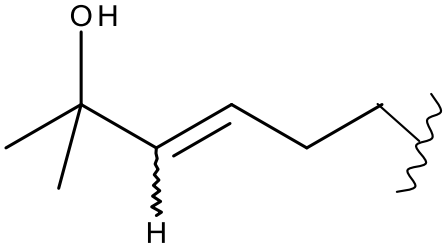
Lyngbyatoxin A
AKA: Teleocidin A-1

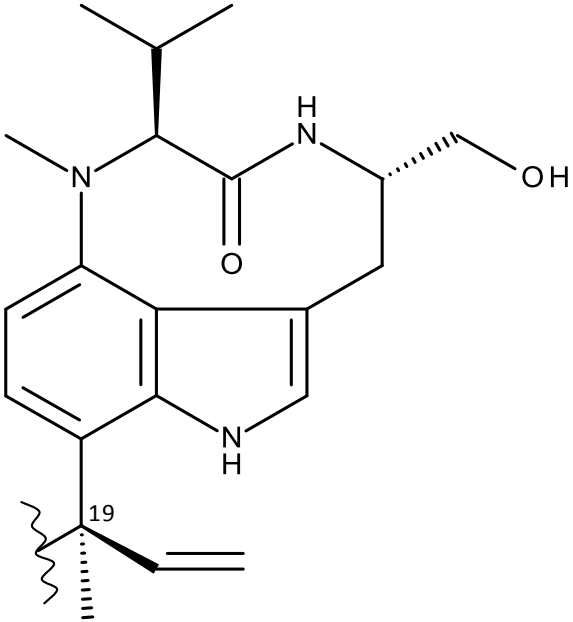


Lyngbyatoxin B

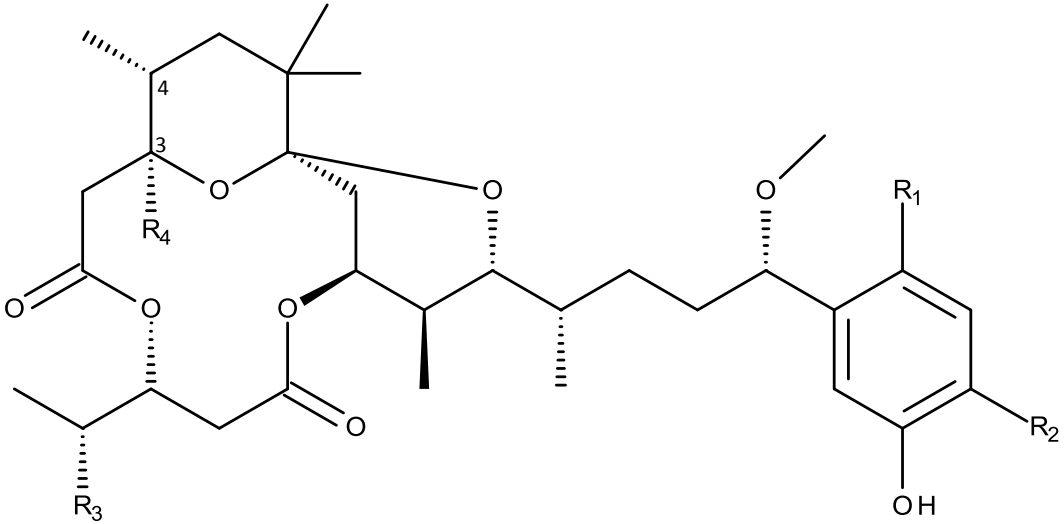


Lyngbyatoxin C





Aplysiatoxin



	R1	R2	R3	R4
Aplysiatoxin (AT)	Br	H	OH	OH
Anhydroaplysiatoxin	Br	H	OH	absent, C3=C4
Debromoaplysiatoxin (DAT)	H	H	OH	OH
Anhydrodebromoaplysiatoxin	H	H	OH	absent, C3=C4
Manauealide A	H	Cl	OH	OH
Manauealide B	H	Br	OH	OH
Manauealide C	H	H	$COCH_3$	OH

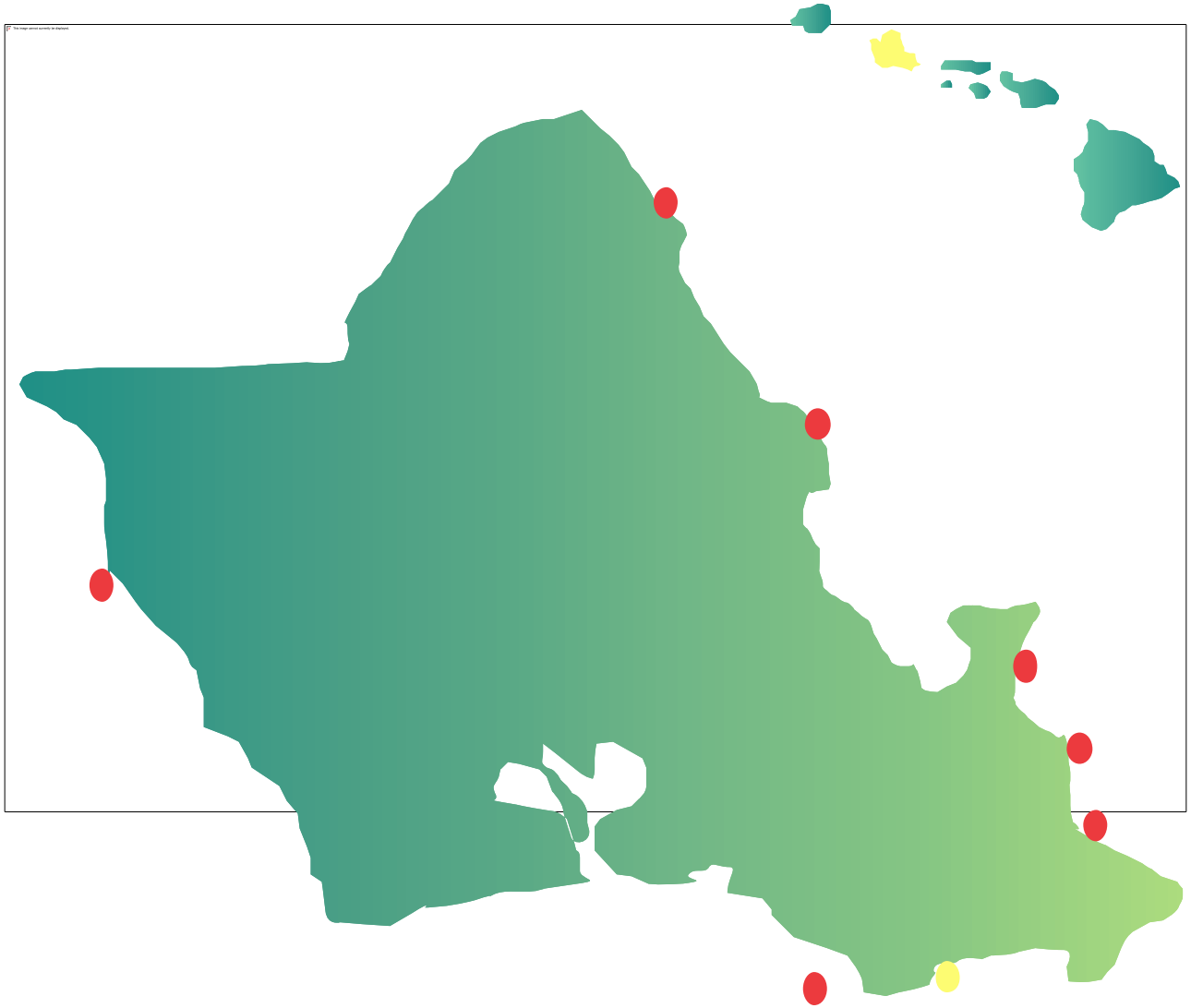
Other Toxins in *Lyngbya*

- Malyngamide A-R - fish antifeedant
- Majusculamide A-D - cytotoxic
- Microcolin A&B - immunosuppressant
- Curacin A-D - anti-mitotic
- Lyngbyastatin - disrupts microfilament networks
- Laxaphycin A&B - cytotoxic
- Geosmin - off flavours and odours

Lyngbya induced epidemics

- 1958 Hawaii, Laie Bay, Kaaawa, Waimanalo
- 1968 Okinawa
- 1976 Hawaii, Laie Bay
- 1980 Hawaii
- 1983 Hawaii, Maui
- 1986 Hawaii, Oahu

Oahu - Hawaii



Lyngbya in QLD

- examine Queensland *L. majuscula* for toxicity
  - isolation and characterisation of toxins
  - mouse ear swelling test
- assess health risks associated with exposure
  - commercial fishers
  - recreational waters

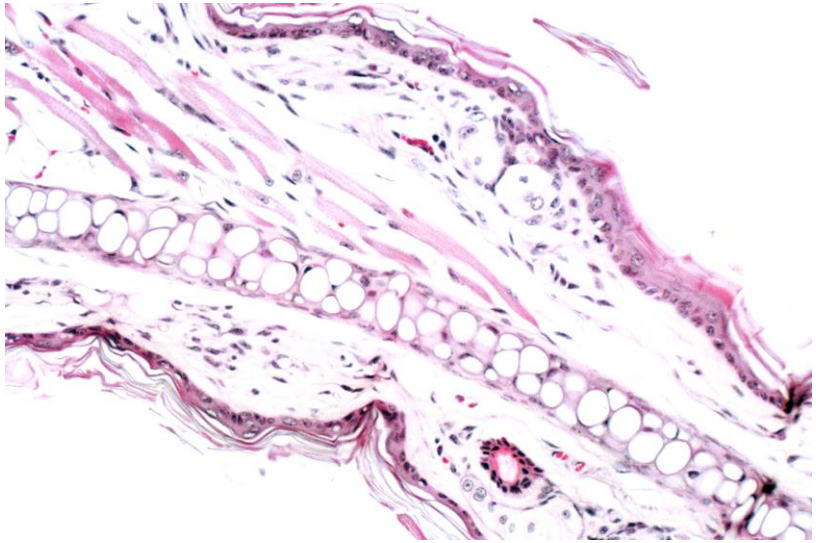
Historical perspective

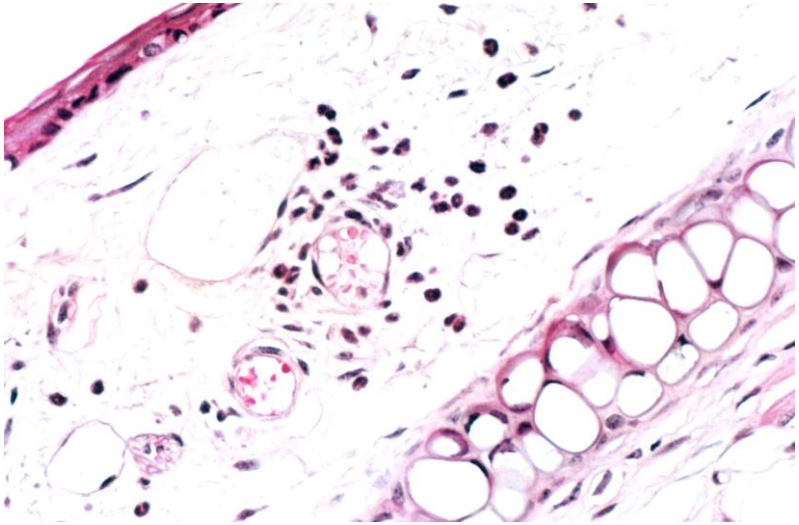
- First noted 1911
- Blanket weed know in the 1950s (stockings)
- 1997 blooms of cyano began around SE Qld.
- Fisher complained of being unable to fish
- Some complained of skin rashes
- Known to the locals but not visitors

Toxicology

- collect alga
- wash, freeze, lyophylise
- extract with acetone
- purify on silica gel column
- LC / MS characterisation

Fast acting toxins: LA and DAT

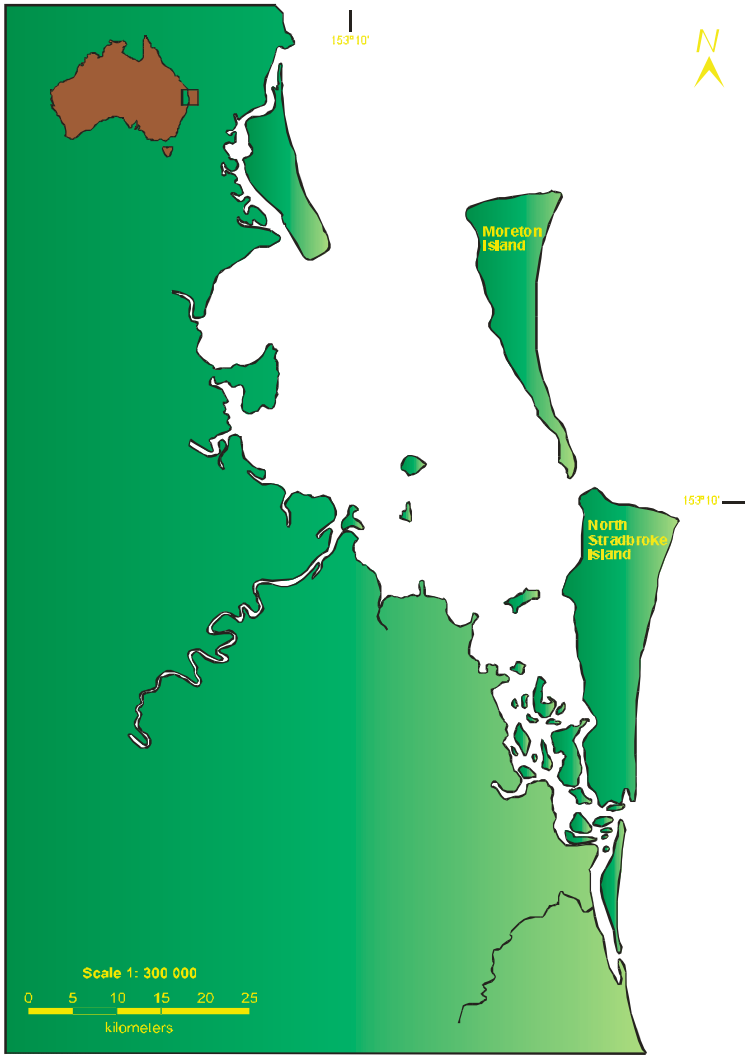




Queensland *Lyngbya*

- DAT and LA both present
- LA may have an epimers (activity)
- Differential distribution
- LA most common
- DAT found only in Pumistone Passage

Moreton Bay


153° 10'
N
Moreton Island
153° 10'
North Stradbroke Island
Scale 1: 300 000
0 5 10 15 20 25
kilometers

Toxins in Moreton Bay (ug/kg)

	Deception Bay		Amity Banks	
	LA	DAT	LA	DAT
20-Jan	436	4843		
28-Feb	2	16588		
14-Mar			35208	0
15-Mar			26249	n/a
25-Mar			23046	0
5-Apr			35598	247
5-Apr	1238	499		

Public Health

- Commercial fishers
- Recreational water users
- Consumers of fish/shellfish
- Consumers of marine reptiles/mammals

Dermatitis in recreational water users

- effect of sewage outfalls in ocean
- schistozomatitis infestations in lakes
- exposure to cyanobacteria

Recreational exposure to cyanobacteria

- sailing, angling, windsurfing, canoeing
- effect of cyanobacteria not significant
- freshwater microalgae

Recreational Water Users: Prospective study

- Fraser Is, Rainbow Beach, Bribie Is
- interview on health and water exposure
- follow up phone interview
- evaluate change in health status

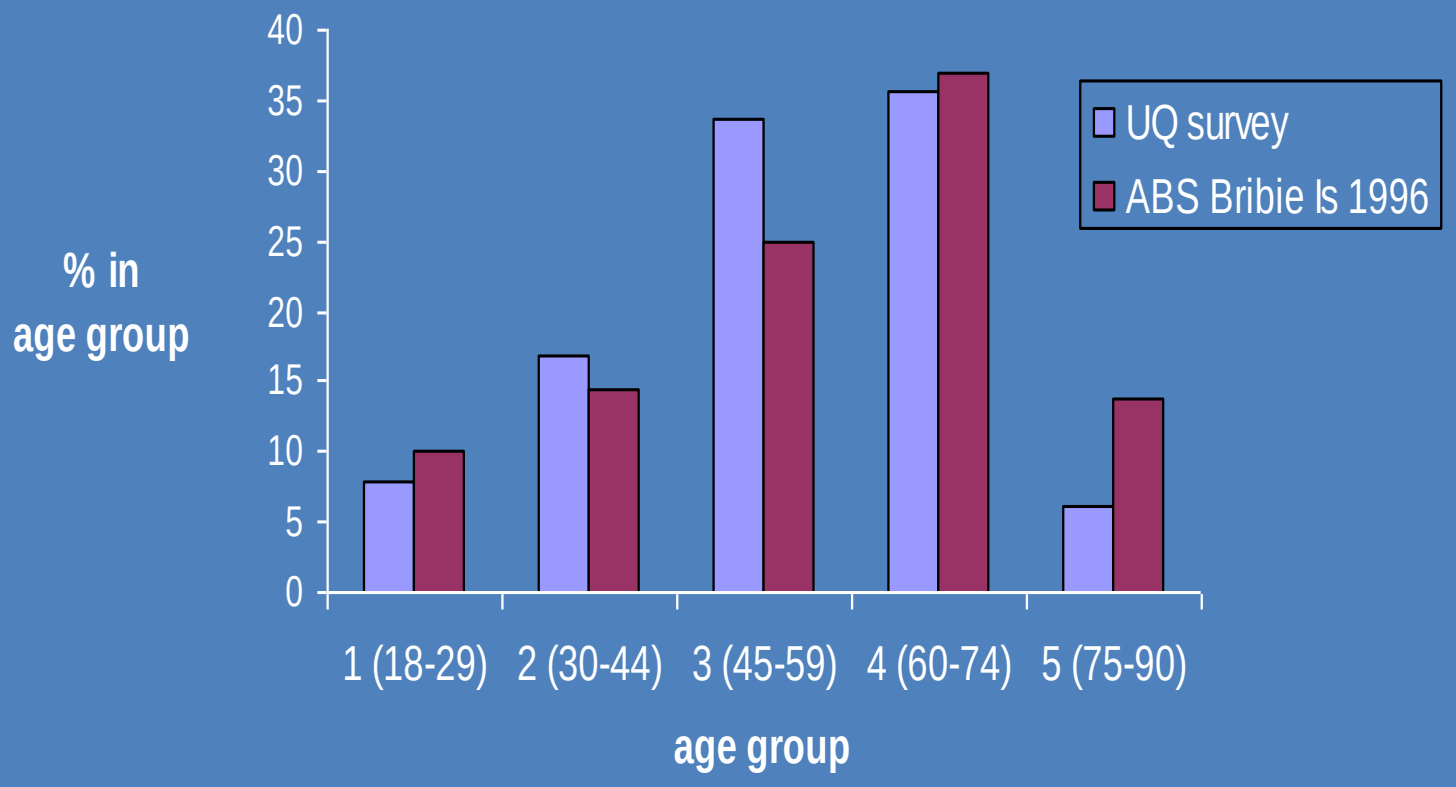
Bribie Island study

- Mailed questionnaire to 5000 residents
- 27% response rate
- 78% reported recreational water activity
- Questions included:
    - no. people effected
    - exposure time
    - body area effected
    - onset of dermatitis
    - healing time-frame
    - cost
    - Effect washing
    - previous allergies/asthma
    - Knowledge of *Lyngbya*

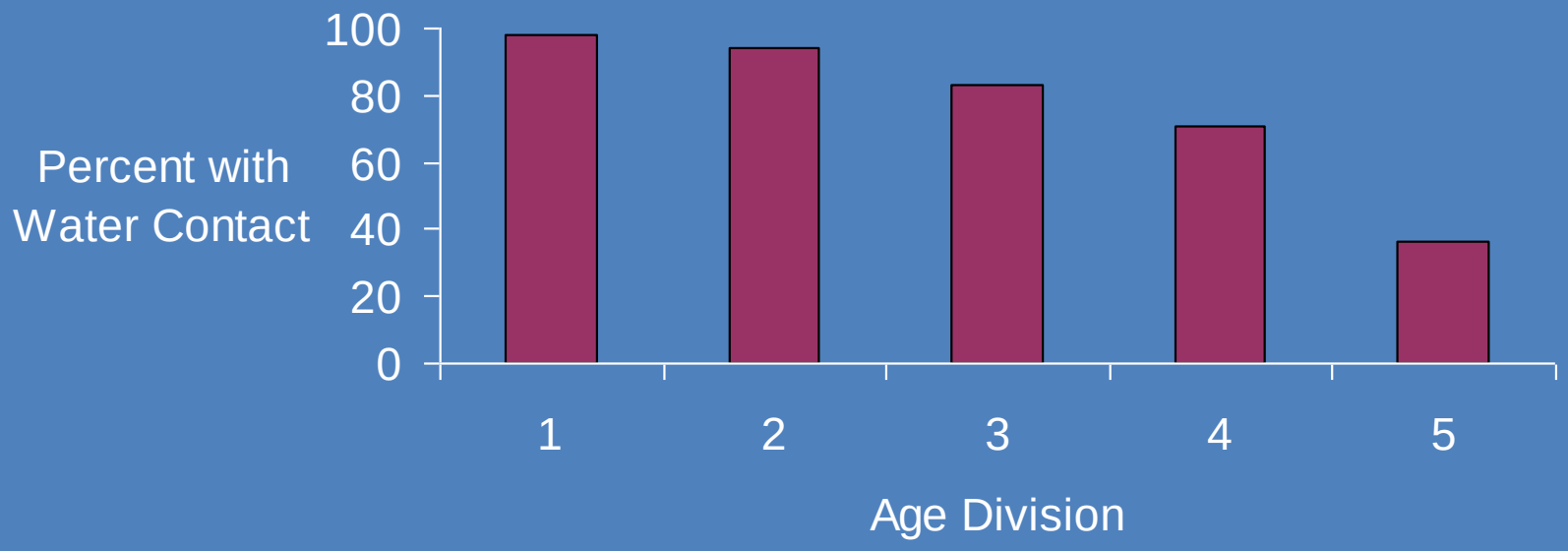
Demographics

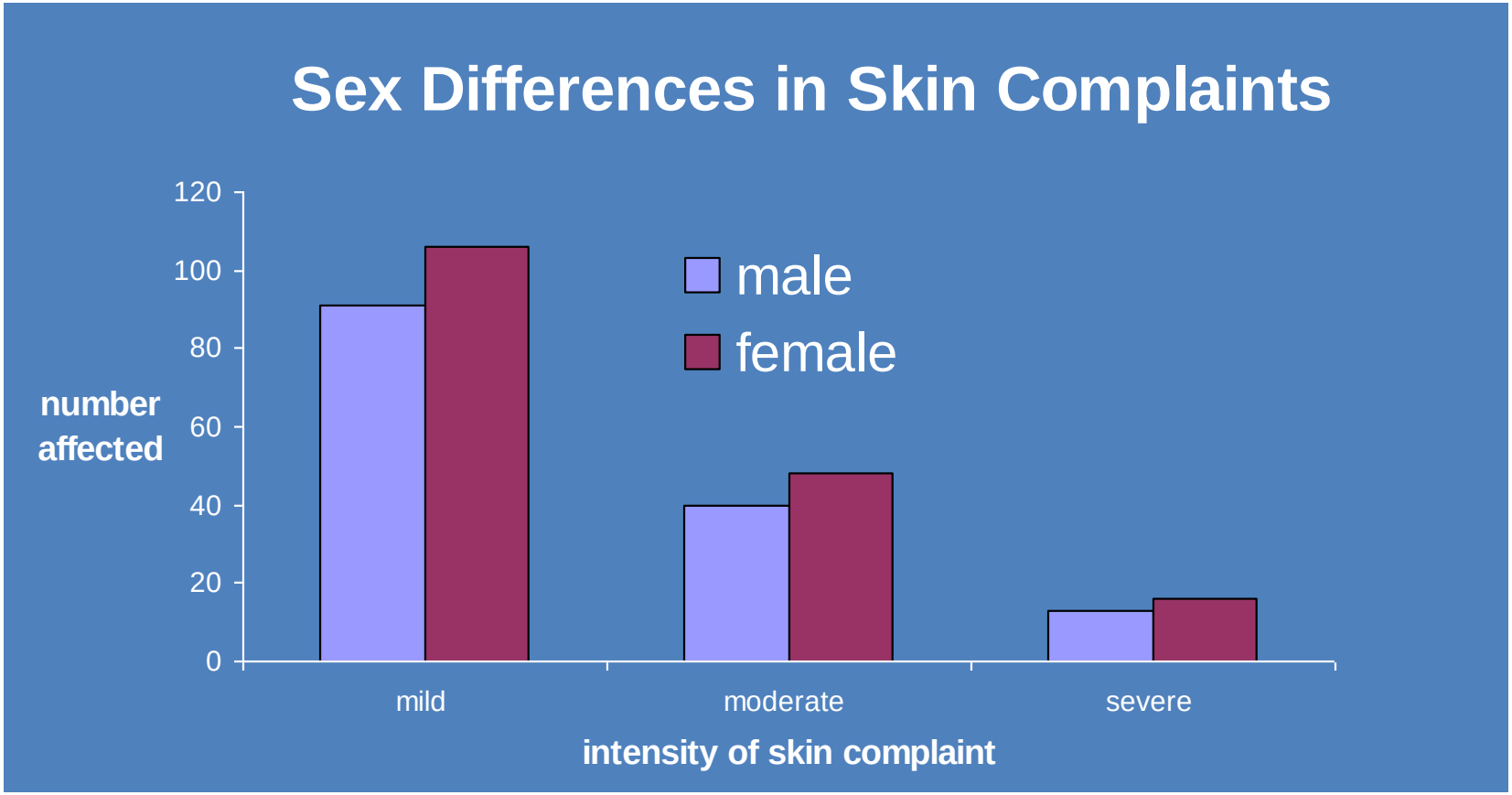
	UQ survey	ABS 1996
age	57.14	50
% male	51.66	47.93
no. in house	2.34	2.2
% unemployed	1.37	5.31
% not in workforce	62.88	51.57

Comparison of survey replies and ABS Statistics

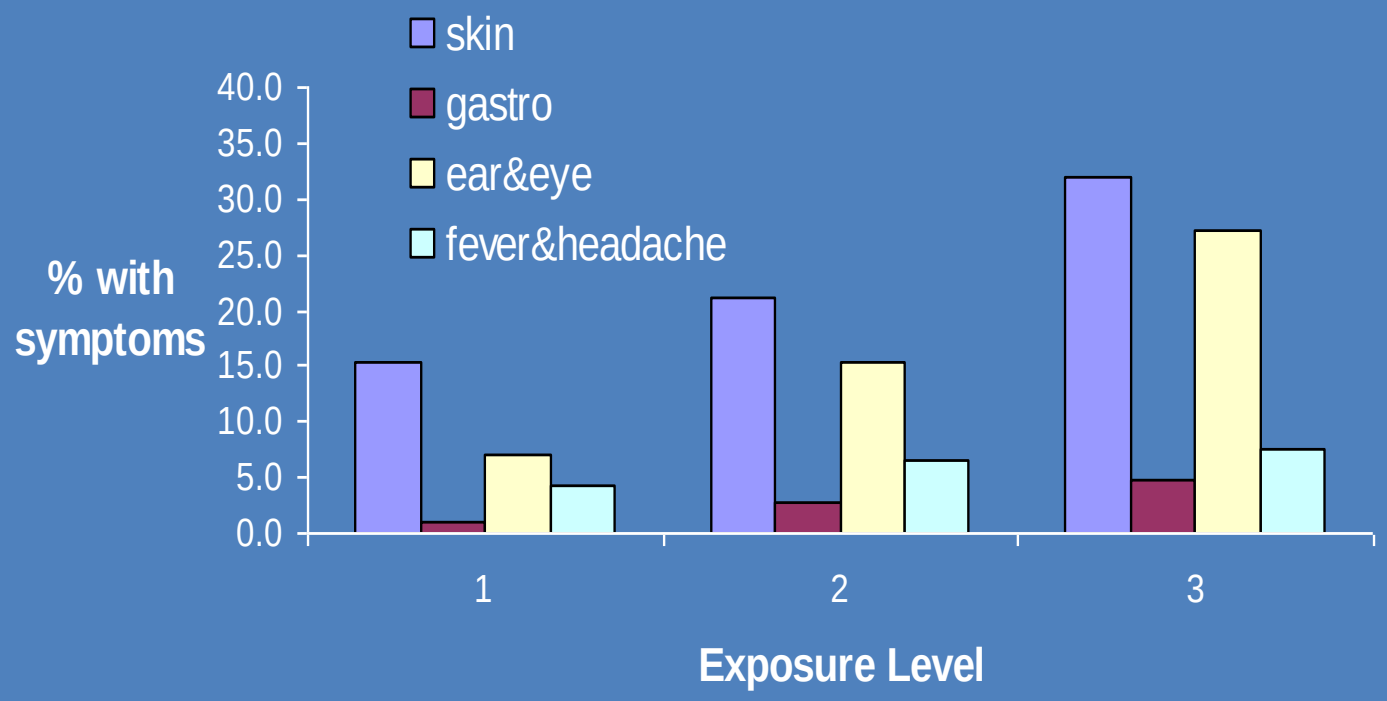


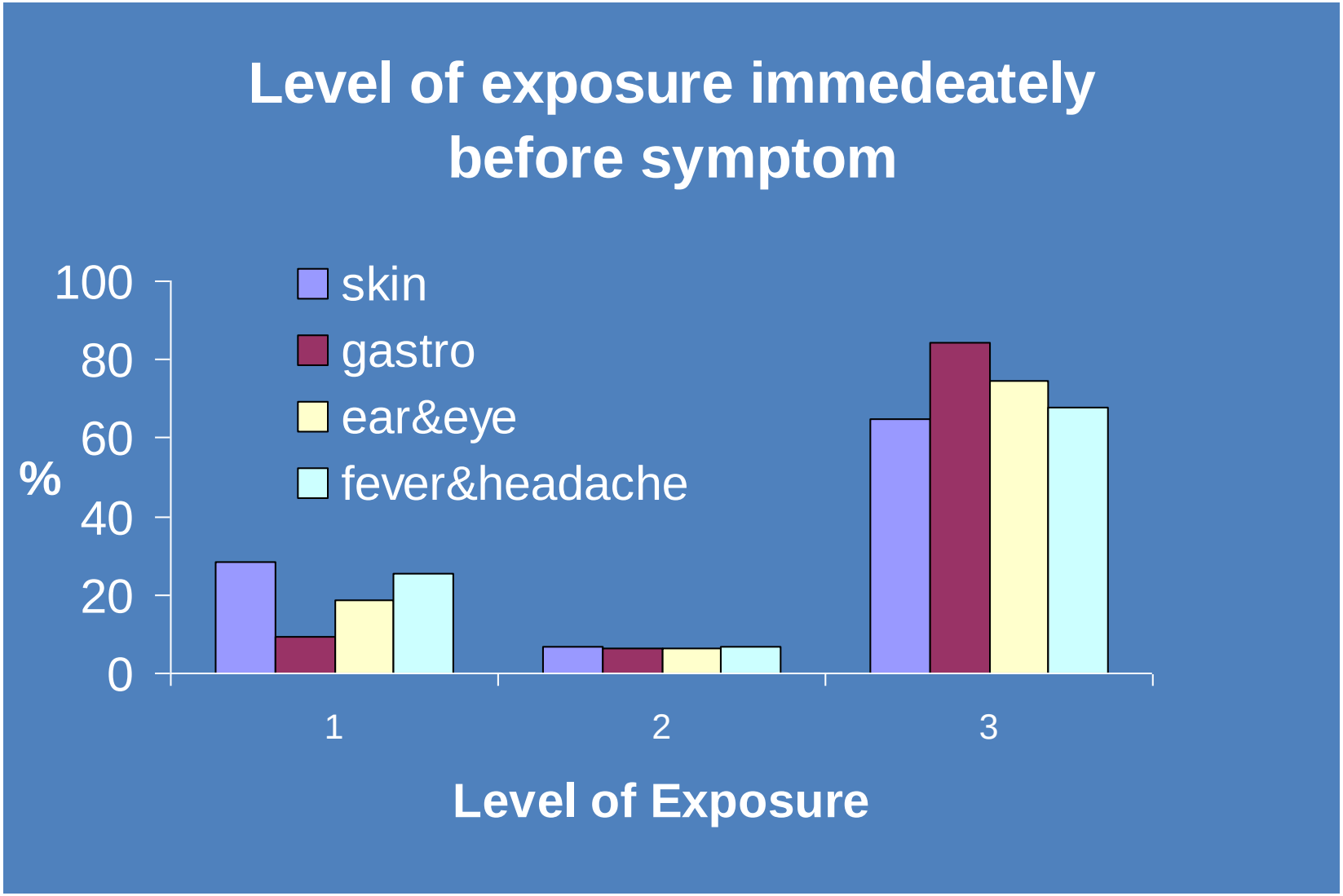
Water contact




Sex Differences in Skin Complaints
120
100
80
60
40
20
0
number affected
male
female
mild
moderate
severe
intensity of skin complaint

Water Exposure Increases Symptoms




Level of exposure immedeately before symptom
100
80
60
40
20
0
%
skin
gastro
ear&eye
fever&headache
1
2
3
Level of Exposure

What does this mean?

- skin complaints after swimming/surfing/diving
- 25.5% of those entering water have skin complaints
- 46.5% of people aged 18-29 had skin complaints
- 10% moderate skin complaint
- 4% severe skin complaint

Study Lacks

- measure of *Lyngbya*
- measure of exposure to *Lyngbya*
- measure of toxicity of *Lyngbya*

Knowledge

- 71.2% know of *Lyngbya* & actively avoid contact
- having heard of *Lyngbya* did not significantly reduce likelihood of skin irritation
- Of those reporting symptoms:
    - 94% return to same location
    - 66% wouldn’t change behaviour

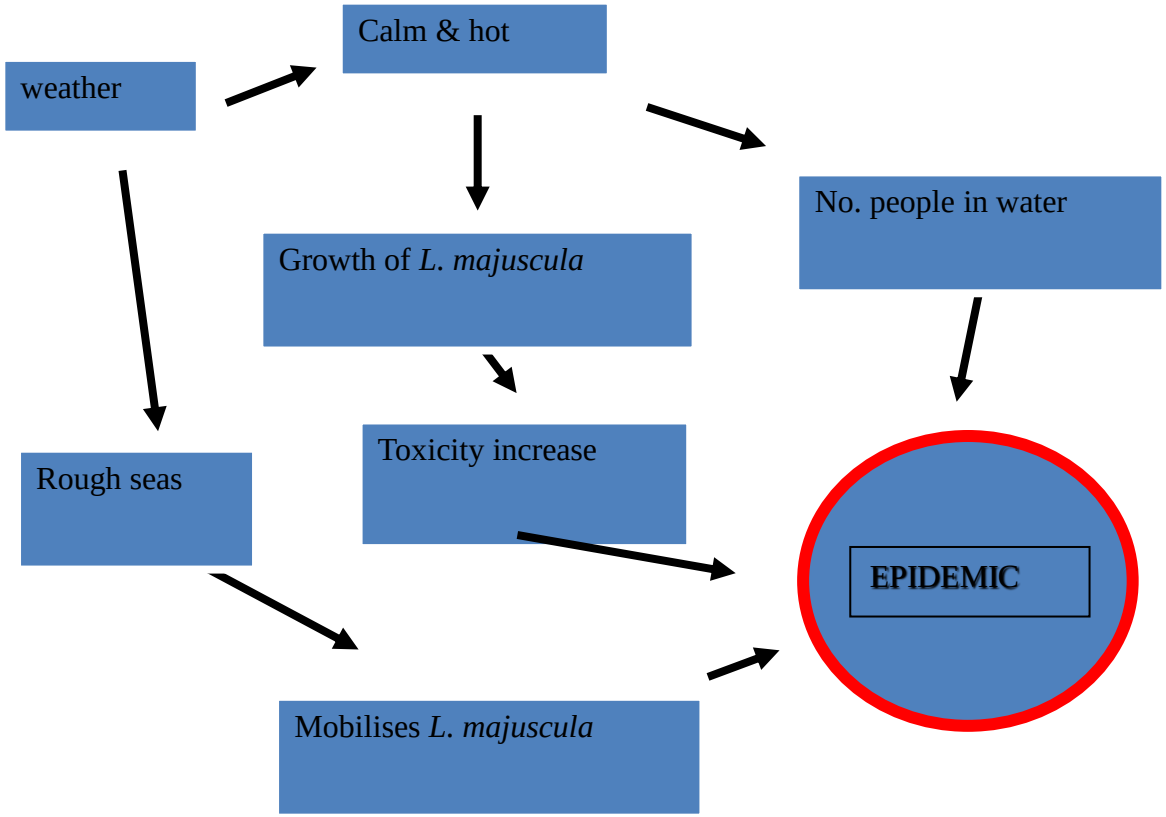
Caveats

- other irritants
- no chemical &/or biological irritants?
- no pathogenic bacteria present
- use of wetsuit wears to control for stingers
- use of sun safety behaviour to control for sunburn

Summary

- Fraser Is. incident occurred over short period of time
- developed model for *Lyngbya* irritation outbreaks
- commercial fishers actively avoid *Lyngbya*
- greater water contact led to higher incidences of skin irritation – *Lyngbya*?

Model of *Lyngbya* risk



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  - *Lyngbya* Task Force

Thank you for listening

Please feel free to contact if you have any questions

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