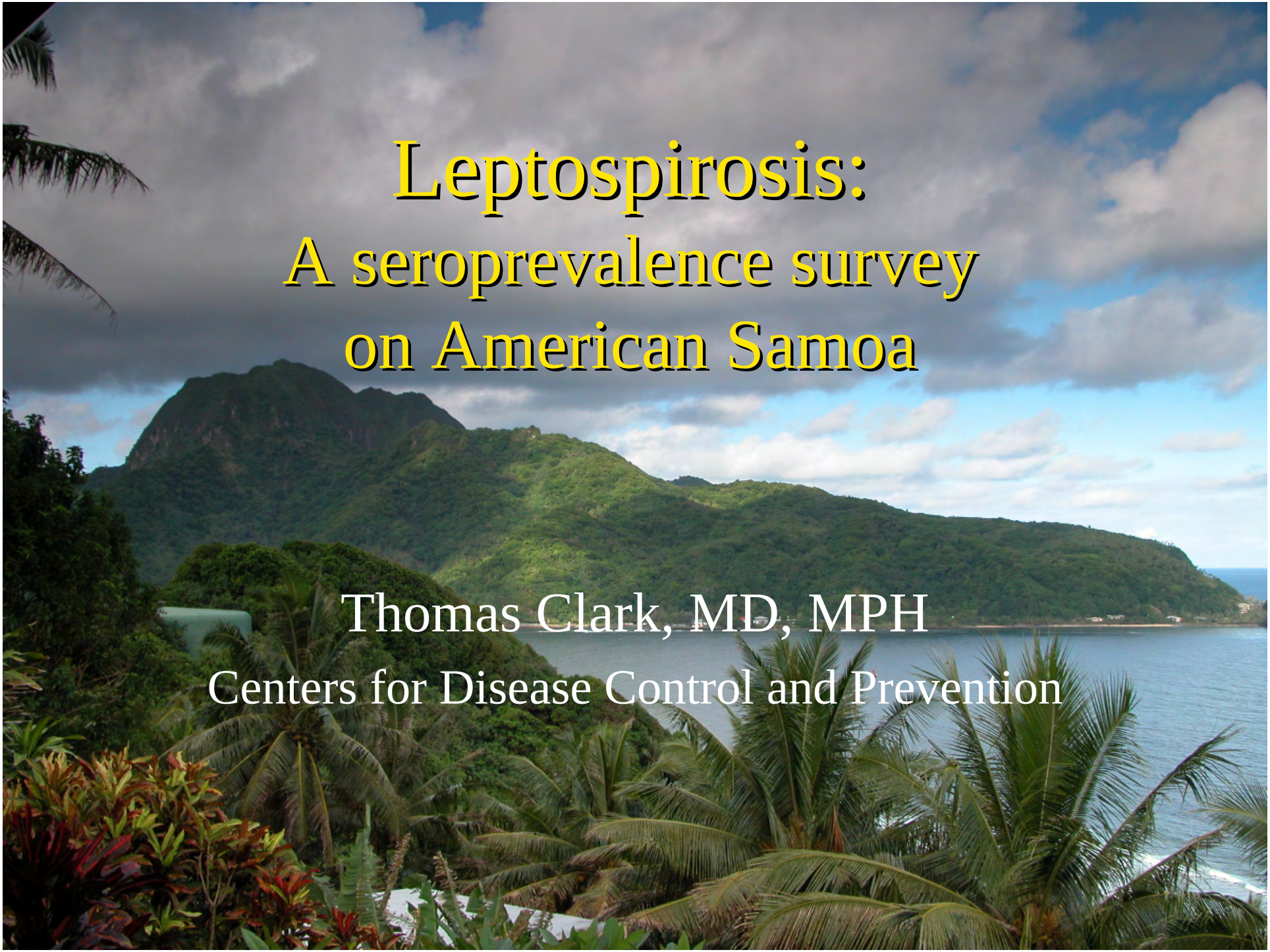


Leptospirosis:
A seroprevalence survey on American Samoa

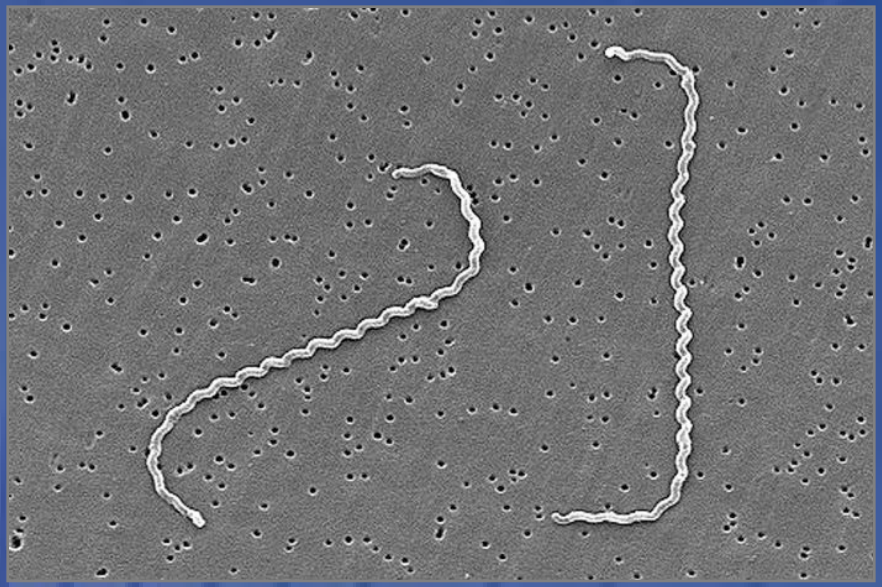
Thomas Clark, MD, MPH
Centers for Disease Control and Prevention

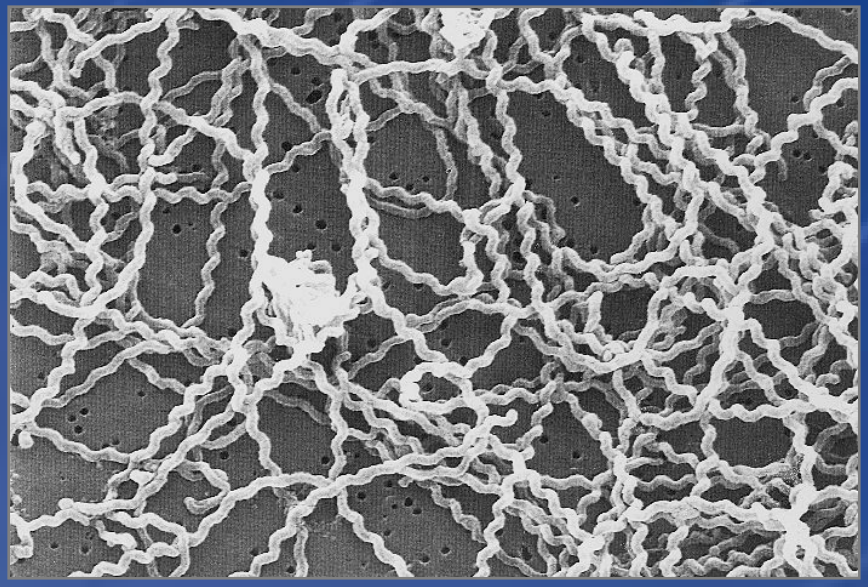
April 2003

- 39yo male construction worker from NZ
- In American Samoa 5 weeks
- Hospitalized with fever, leg pain, headache
- Day 2: hypoxic, shock, ICU
- Day 3: intubated, kidney failure
- Day 6: evacuated to NZ
- Day 8: elevated titer to *Leptospira* (1:1600)

Leptospira interrogans

- Pathogenic bacterium (spirochete)
  - Over 200 antigenically-distinct serovars
  - Serogroups epidemiologically useful



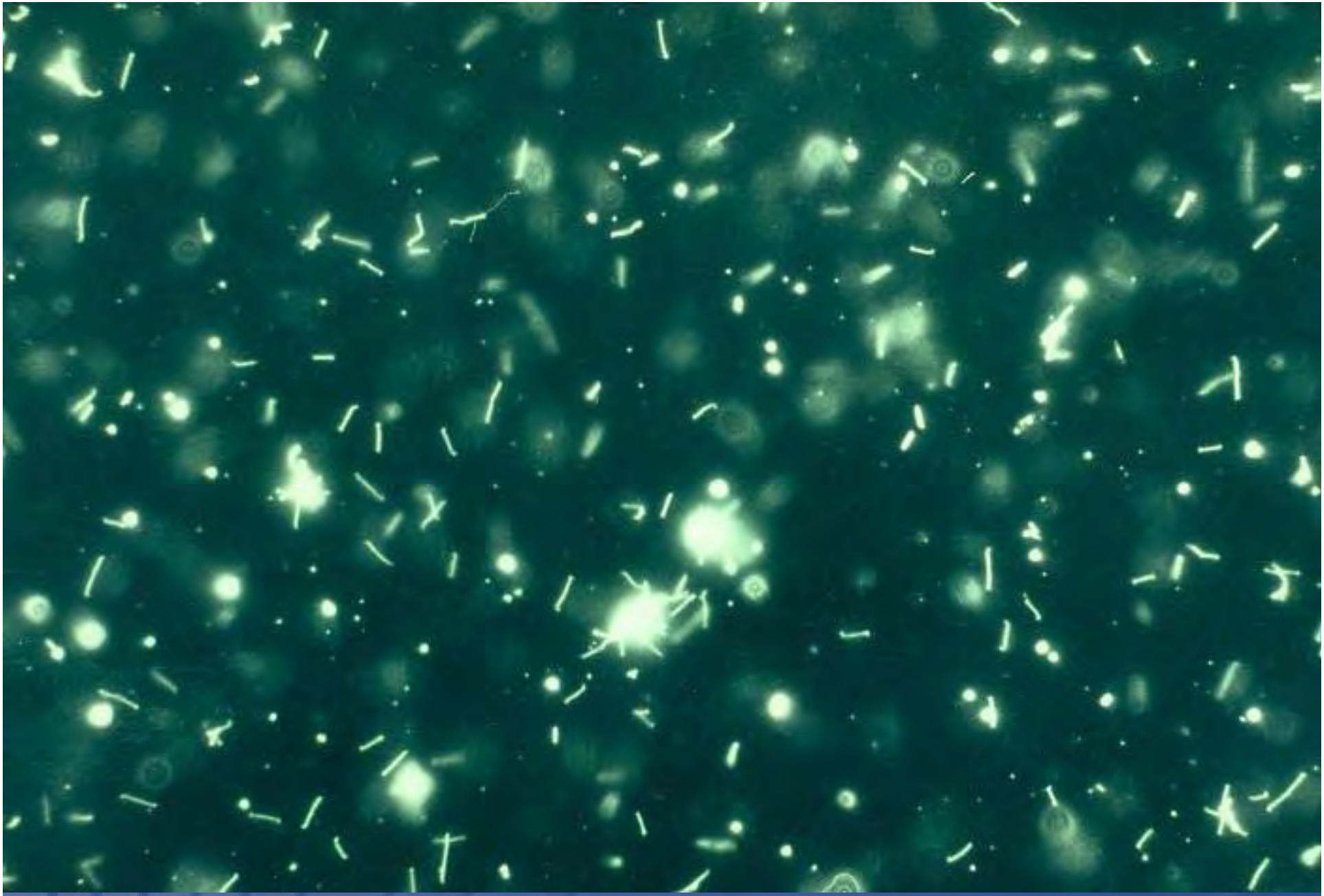


Leptospirosis

- Majority subclinical or mild
- Sudden onset fever - septicemic phase
- Headache, chills, abdominal pain, red eyes
- Immune phase - second week
  - Antibody production
  - Resolution
- Weil's disease
  - Leptospires in organs - kidney, liver failure
  - Mortality ~5%

MAT testing

- Diagnosis
  - Serum reacted with live antigen
  - Examined microscopically for agglutination
  - Titer determined by serial dilutions
- Epidemiology
  - Serogroup specific
  - Titers may months to years to fall
  - Seroprevalence surveys



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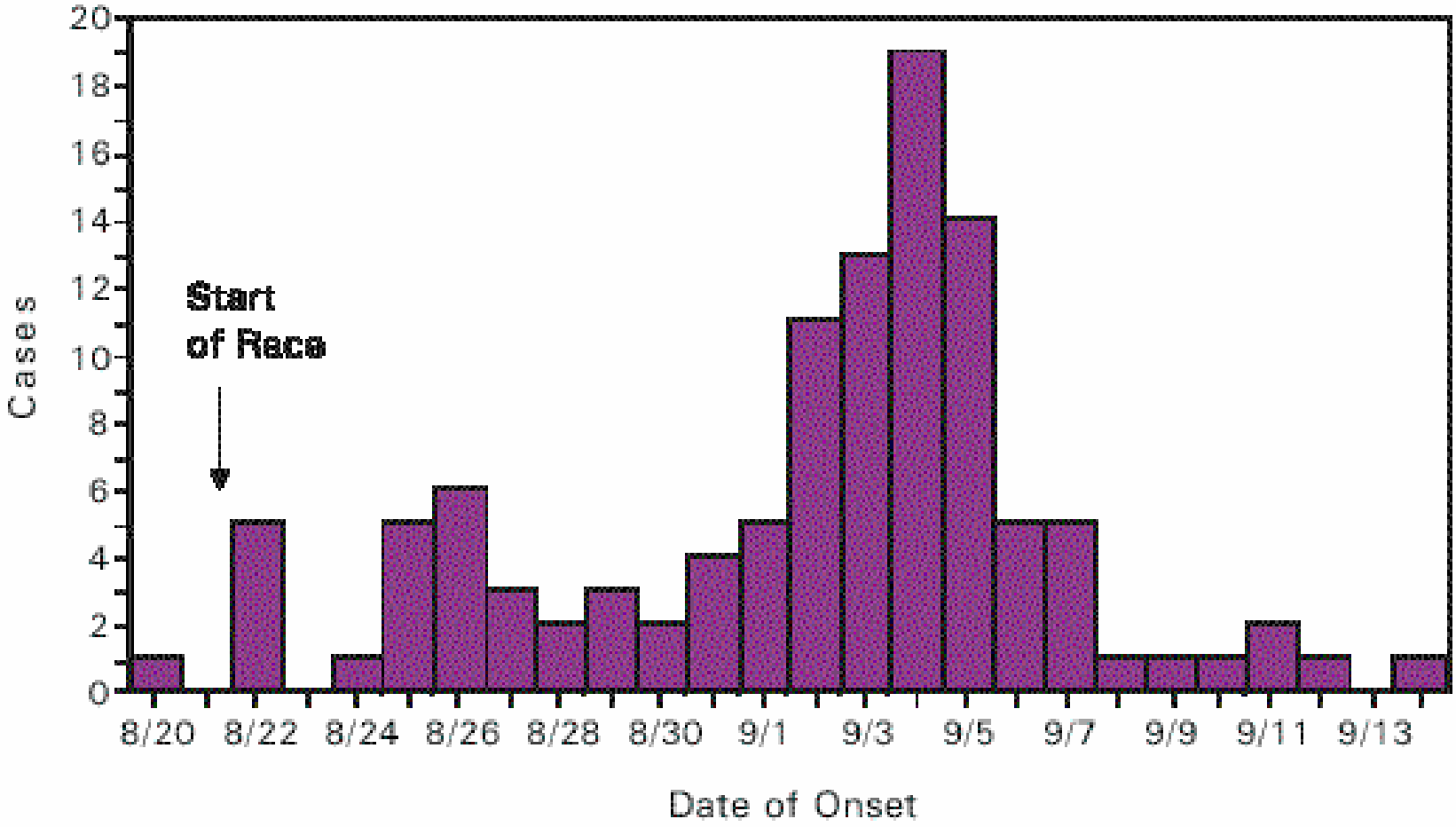
Epidemiology

- Most common zoonosis world-wide
- Endemic in warm, wet climates
- Seasonal outbreaks
  - Summer, fall in temperate regions
  - Rainy seasons in warm regions
- Route of entry
  - Non-intact skin
  - Conjunctiva, mucous membranes

Exposures

- Direct contact with infected animals
- Indirect contact with animal urine in water
- Occupational
  - Farmers, vets, abattoir workers, meat inspectors
  - Sewer workers, soldiers, taro and banana farmers
- Avocational - water, soil, animals
- Recreational - water

FIGURE 1. Number of athletes with symptoms who participated in the Eco-Challenge race, by date of onset — Borneo, Malaysia, August 20–September 14, 2000*



* n=109.

Animal hosts

- Maintenance
  - Maintain infection in nature
  - Chronic infection of kidneys
  - Excretion in urine
- Accidental (incidental)
  - Infected by maintenance hosts
  - Climate, population density, degree of contact

Maintenance hosts and associated serogroups and serovars

Mammal species	Serogroup, serovar
Rats	Icteroaemorrhagiae, Ballum
Mice	Ballum
Dairy cattle	hardjo, pomona, grippotyphosa
Pigs	pomona, tarrassovi, bratislava
Sheep	hardjo, pomona
Dogs	canicola

Maintenance hosts on American Samoa

- Rodents
  - *Rattus norvegicus, rattus, exulans*
  - *Mus musculus*
- Other mammals
  - Dogs
  - Few cattle, horses
  - Domestic and feral pigs (pop. ~30,000)

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Leptospirosis in the Pacific

Location	Incidence rate per 100,000 persons/yr
Hawaii	128
New Caledonia	90
Tahiti	30
New Zealand	4.4
American Samoa	?

Study objectives

- Determine the seroprevalence of leptospirosis in adults
- Identify risk factors associated with seropositivity

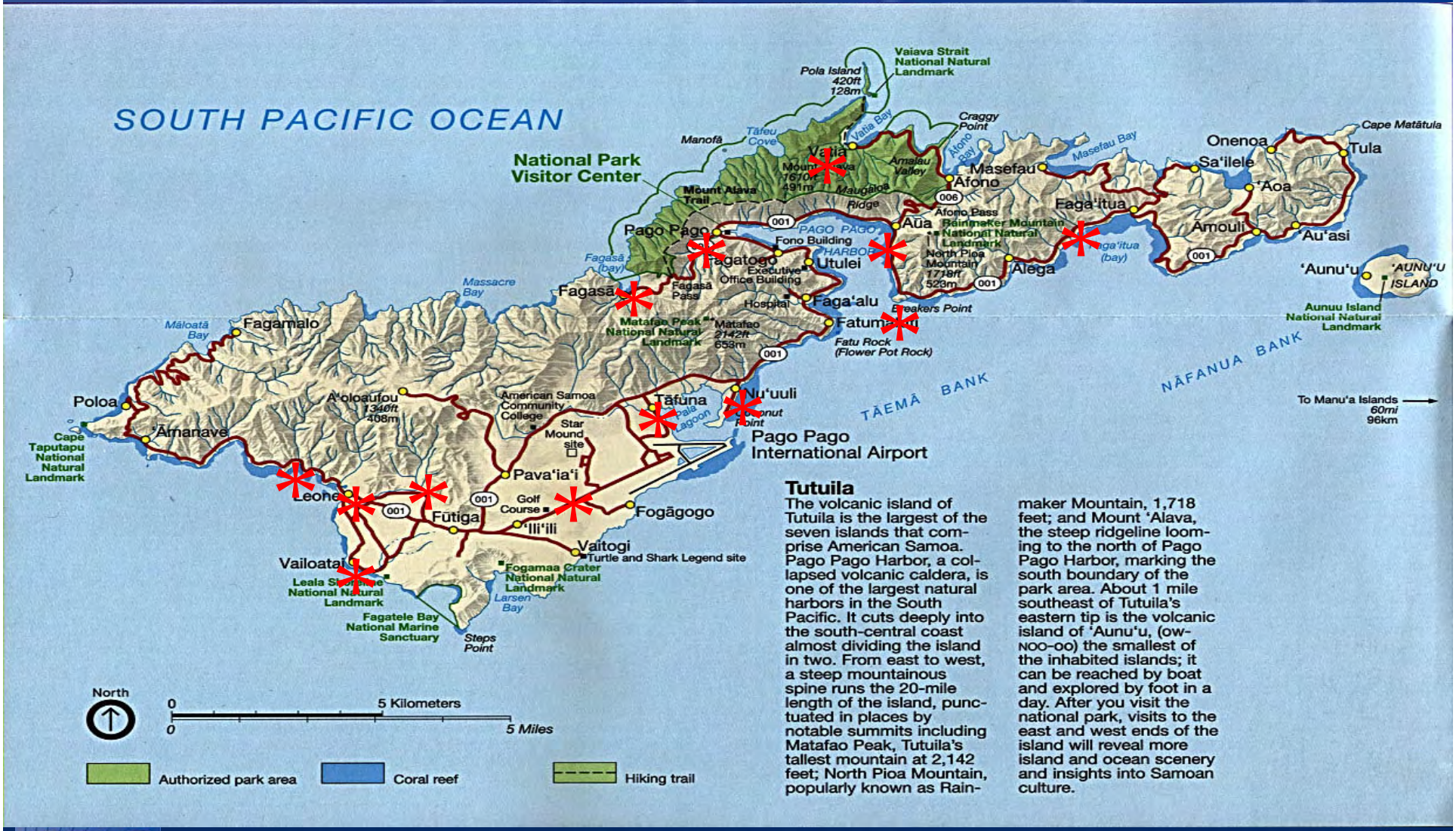
Study design

- Cross-sectional seroprevalence survey
- Adults (≥ 18 years)
- Demographic and risk factor data
  - Occupational and recreational exposures
  - Direct/indirect exposure to animals
  - Exposure to surface water and soil

Sampling strategy

- Sample size (n=360)
  - Assumed seroprevalence 10%
  - Included non-participation
- Population (70,260) primarily in 73 villages on Tutuila
- Selected 15 villages
  - Randomly
  - Probability proportional to population

Village selection

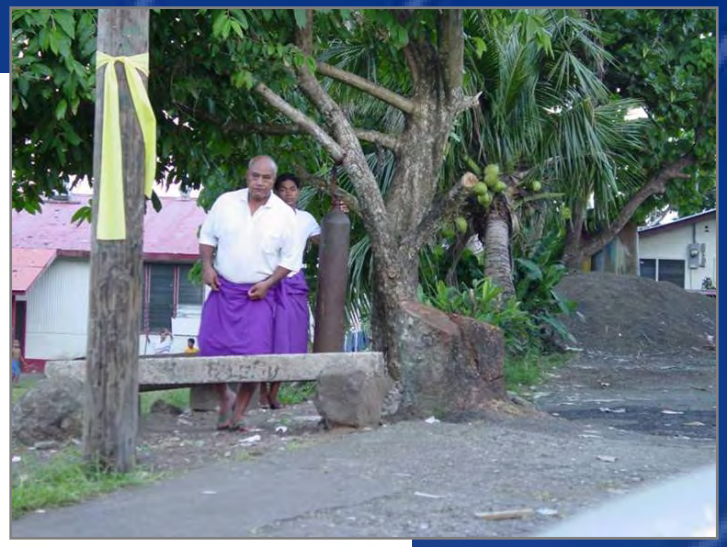


Tutuila

The volcanic island of Tutuila is the largest of the seven islands that comprise American Samoa. Pago Pago Harbor, a collapsed volcanic caldera, is one of the largest natural harbors in the South Pacific. It cuts deeply into the south-central coast almost dividing the island in two. From east to west, a steep mountainous spine runs the 20-mile length of the island, punctuated in places by notable summits including Matafao Peak, Tutuila's tallest mountain at 2,142 feet; North Pioa Mountain, popularly known as Rainmaker Mountain, 1,718 feet; and Mount 'Alava, the steep ridgeline looming to the north of Pago Pago Harbor, marking the south boundary of the park area. About 1 mile southeast of Tutuila's eastern tip is the volcanic island of 'Aunu'u, (ow-NOO-oo) the smallest of the inhabited islands; it can be reached by boat and explored by foot in a day. After you visit the national park, visits to the east and west ends of the island will reveal more island and ocean scenery and insights into Samoan culture.

Participant selection

- 24 households per village
  - Maps
  - Walking sampling strategy
- 1 participant per household
  - Adult
  - Resident for 12 months
  - No current fever, medical conditions
  - Informed consent



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Preliminary results*

- Participants (n=341)
  - 55% female
  - Median age 40 years (range 18-86 years)
  - Median residence 23 years (range 1-73 years)
  - 93% Samoan
- Serum samples (n=341)
  - 20/211 (9.5%) reactive

*Results presented are preliminary, and may change with further analysis.

Seroprevalence data from selected surveys

Location	Population	Prevalence
Italy	Healthy subjects	8.3%
Italy	Railway workers	10.4%
Italy	Healthy subjects in outbreak setting	13.8%
Glasgow	Sewer workers	17%
Barbados	Healthy subjects	18.5%
Spain	High-risk workers	21.3%
Trinidad	Healthy subjects	21.9%
Italy	High-risk workers	11.8-40%

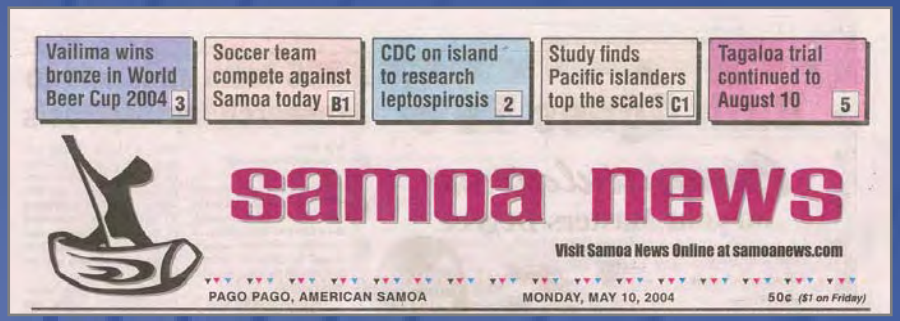
Maintenance hosts and associated serogroups and serovars

Mammal species	Serogroup, serovar
Rats	Icterohemorrhagiae, Ballum
Mice	Ballum
Dairy cattle	hardjo, pomona, grippotyphosa
Pigs	pomona, tarrassovi, bratislava
Sheep	hardjo, pomona
Dogs	canicola

Prevention

- No human vaccine
- Questionable efficacy of chemoprophylaxis
- Problematic animal vaccines
- Animal waste management
- Rodent control
- Public awareness
- Protective clothing
- Limiting high-risk activities
- Improved surveillance

Acknowledgments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