

Leptospirosis in French Polynesia: 11 years of surveillance data, 2007–2017

N. Bouscaren, C. Benoit de Coignac, S. Lastère, D. Musso, Y. Teissier, J. Formont, F. Chaix, M. Giard

► **To cite this version:**

N. Bouscaren, C. Benoit de Coignac, S. Lastère, D. Musso, Y. Teissier, et al.. Leptospirosis in French Polynesia: 11 years of surveillance data, 2007–2017. *New Microbes and New Infections*, Wiley Online Library 2019, 29, pp.100518. 10.1016/j.nmni.2019.100518 . hal-02263685

HAL Id: hal-02263685

<https://hal-amu.archives-ouvertes.fr/hal-02263685>

Submitted on 22 Oct 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



1 **Title:** Leptospirosis in French Polynesia: 11 years of surveillance data, 2007-2017

2

3 **Article type:** original article

4

5 **Authors and affiliations:** Bouscaren N¹, Benoit de Coignac C², Lastère S³, Musso D⁴⁻⁵, Teissier Y⁶,
6 Formont J⁶, Chaix F⁷, Giard M⁶

7 1- Inserm CIC1410, CHU Réunion, Saint Pierre, France.

8 2- Private praticioner, Réunion, France

9 3- Laboratoire de biologie médicale et d'anatomie pathologique, Centre hospitalier de la
10 Polynésie française, Pirae, Tahiti, Polynésie française

11 4- Unit of Emerging Infectious Diseases, Institut Louis Malardé, Papeete, Tahiti, Polynésie
12 française

13 5- Aix Marseille Univ, IRD, AP-HM, SSA, VITROME, IHU-Méditerranée infection, Marseille,
14 France

15 6- Bureau de veille sanitaire, Direction de la santé, Papeete, Tahiti, Polynésie française

16 7- Service de médecine interne, Centre hospitalier de la Polynésie française, Pirae, Tahiti,
17 Polynésie française

18

19 **Corresponding author:**

20 Dr Nicolas Bouscaren

21 Inserm CIC 1410, CHU Sud Réunion, BP 350, 97448 Saint Pierre Cedex, Réunion, France

22 Tel : +262 (0)262 71 98 30

23 Email : nicolas.bouscaren@chu-reunion.fr / n.bouscaren@gmail.com

24

25 **Word count:** Abstract 192, text 2164

26

27 **Tables and Figures:** Table: 2, Figure: 2

28

29 **Reference:** 35 (max 50)

1 **Title:** Leptospirosis in French Polynesia: 11 years of surveillance data, 2007-2017

2

3 **Abstract**

4 Leptospirosis is a worldwide zoonosis with higher incidence in tropical areas and is a neglected
5 disease in the Pacific region. French Polynesia is a French overseas Territory located in the South
6 Pacific. Data on the epidemiology in French Polynesia are scarce. In this study, we described our
7 understanding of leptospirosis epidemiology in French Polynesia and discussed the prospects
8 concerning this disease and its surveillance to better address preventive actions. We reported 11 years
9 of surveillance data between January 1st 2007 and December 31st 2017. Over the study period 1,356
10 confirmed and probable leptospirosis cases were reported, the mean annual incidence rate was 46.0
11 (95%CI 43.6-48.5) cases per 100,000 inhabitants, we registered 864 (63.7%) hospitalisations, among
12 them, at least 270 (19.9%) were in intensive care unit and 24 (1.8%) patients died. Even if incidence of
13 leptospirosis is lower in French Polynesia compared to most of other Pacific countries and Territories,
14 our data confirms that the disease is highly endemic in our country. Despite all preventive measures,
15 leptospirosis remains a major public health concern in French Polynesia, highlighting the need to
16 maintain intensive leptospirosis surveillance, medical staff training and information of the general
17 population.

18 **Introduction**

19 Leptospirosis is a worldwide bacterial zoonosis, with a significant health burden on economically
20 vulnerable population [1–3]. It is a neglected tropical disease, especially in the Pacific Region [4–6].

21 Leptospirosis is caused by spirochetes of the genus *Leptospira*, bacteria belonging to the
22 *Leptospiraceae* family [7,8]. Many mammals' species, wild or domestic, can carry the pathogen.
23 Rodents are the main reservoir of *Leptospira* [1]. Epidemiology of leptospirosis is characterized in the
24 Pacific islands by a potentially important role of livestock farming animals [4].

25 Human contamination results from contact of abraded skin or mucous membranes with urine or tissues
26 of infected animals, directly or indirectly via contaminated water or wet soil [1,9,10]. Spectrum of the
27 disease range from subclinical infection as flu-like symptoms to severe disease with multi-visceral
28 complications like acute renal failure, pulmonary haemorrhage (Weil's disease), and death [1,9,11].
29 Treatment is based on early antibiotic therapy. The vaccine only protects against the serovar
30 Icterohaemorrhagiae, the most frequently responsible for severe human infections, and it must be
31 renewed every two years.

32 Annual worldwide incidence of leptospirosis is estimated at 1 million cases, with 5-15% of severe
33 diseases [12] and about 60,000 deaths [13]. Leptospirosis is responsible for 2.9 million Disability
34 Adjusted Life Years (DALYs) per annum with a preponderant occurrence among low and middle-

35 income tropical countries and males [2]. The burden of leptospirosis is underestimated because of high
36 proportion of sub-clinical and asymptomatic infections, lack of notification systems, and poor access
37 to accurate laboratory diagnosis in low and middle-income countries [1,14–16]. World Health
38 Organisation (WHO) created in 2009 the Leptospirosis Burden Epidemiology Reference Group
39 (LERG), with the goal to conduct research and develop policy targeted towards decreasing the burden
40 of leptospirosis [17].

41 Pacific Islands have highly favourable environmental conditions for transmission of leptospirosis: hot
42 and humid tropical and subtropical climate with high rainfall, recurrent flooding, poverty,
43 urbanization, local life style (barefoot walking, swimming), and occupational activities [15].
44 Knowledge of the global burden of leptospirosis in the Pacific region remains incomplete, principally
45 due to the lack of laboratory capacities to confirm cases.

46 French Polynesia (FP) is a French overseas Territory located in the South Pacific, constituted of five
47 archipelagos: Society, Marquesas, Tuamotu-Gambier and Austral Islands. The population is about
48 280 000 inhabitants (2017 census), spread in 72 inhabited islands with 70% of the population living
49 on Tahiti Island [18]. Few data on the epidemiology of leptospirosis in FP exist [4,19] with the first
50 human infections reported only in 1959 [20]. Number of reported cases per year between 2006 and
51 2012 ranged between 79 and 127 and the annual incidence between 30 and 49 cases per 100,000
52 inhabitants [21–23].

53 In this study, we described our understanding of leptospirosis epidemiology in FP and discussed the
54 prospects concerning this disease and its surveillance to better address preventive actions.

55 **Methods**

56 We reported 11 years of surveillance data between January 1st 2007 and December 31st 2017. In FP, all
57 probable and confirmed leptospirosis cases are collected by the local health authority (*Bureau de veille*
58 *sanitaire*), based on notification forms filled in by general practitioners, and laboratory results
59 provided by laboratories of the “*Institut Louis Malardé*” and of the “*Centre Hospitalier de la*
60 *Polynésie française*”.

61 Case definition

62 Confirmed case: leptospirosis symptoms with either isolation of bacteria by culture or of its DNA by
63 polymerase chain reaction (PCR) or seroconversion of specific immunoglobulin class M (IgM).

64 Probable case: leptospirosis symptoms and IgM detection ELISA on a single serum collected more
65 than 1 week post symptoms onset.

66 Excluded case: leptospirosis symptoms with PCR negative on sera collected within the first week post
67 symptoms onset or ELISA IgM negative on sera collected more than 1 week post symptoms onset.

68 Demographic data were provided by the FP statistic institute [24]. Population estimation along the
69 duration of the study was calculated using an exponential increase during two consecutive censuses.

70 All confirmed and probable cases were included in statistical analysis. Qualitative variables were
71 described using frequency and percentages. Quantitative variables were described using mean \pm
72 standard deviation [minimum-maximum]. Annual Incidence rates (AIRs), meaning number of cases
73 per 100,000 persons year (PY), were presented with 95% confidence intervals (95%CI), based on the
74 Poisson model. We used a Z test for comparing AIRs between genders and between archipelagos.
75 Relative Risks (RR) with corresponding 95% CI were computed. A p level of <0.05 was considered
76 statistically significant. All statistical analyses were performed using STATA® V13.1 software
77 (StataCorp LP, Lakeway Drive, College Station, Texas 77845 USA) for Windows. Mapping was done
78 using the QGIS® v2.18.1 software and Google Earth Pro®.

79 **Results**

80 Between 1 January 2007 and 31 December 2017, 1,356 leptospirosis cases were reported: 851 (62.8%)
81 confirmed and 505 (37.2%) probable. Over the study period the AIR was 46.0 (95%CI 43.6-48.5)
82 cases per 100,000 PY (Figure 1a). Median number of cases on decade was 109 with a peak in 2017
83 with 199 cases corresponding to an AIR of 72.1 (95%CI 62.5-82.9) cases per 100,000 PY.

84 A total of 1,032 (76.1%) cases were reported in men cases and 324 (23.9%) in women (sex ratio 3.2)
85 with an overall average age of 33.7 ± 16.2 [2-80] on men and 35.2 ± 17.8 [1-88] on women. Comparison
86 of AIRs showed a significant excess risk of contamination in men [68.5 (95%CI 64.4-72.8) cases per
87 100,000 PY] vs women [22.4 (95%CI 20.1-25) cases per 100,000 PY], RR=3.1 (IC 95% 2.7-
88 3.5), $p < 0.001$. The age group repartition showed the largest number of cases was [20-29] years with
89 332 (24.5%) cases representing a peak AIR of 66.8 (95%CI 59.8-74.4) cases per 100,000 PY. During
90 the whole period, cases were reported throughout the year, but mostly between January and May with
91 a noticeable decrease from August to December (Figure 1b).

92 **Geographical distribution**

93 Island of residence was available for 1,282 (94.5%) cases. The Society archipelago accounted for
94 95.5% of cases with an annual average of 114.7 ± 35.1 [74-192] cases. The AIRs per archipelago were
95 48.8 (95%CI 46.1-51.6) cases per 100,000 PY for the Society, 53 (95%CI 39.8-69.2) for the
96 Marquesas, 1.3 (95%CI 0.0-7.4) for the Austral, and 2.2 (95%CI 0.6-5.5) for the Tuamotu Gambier.
97 Map, number of cases, AIRs and RR by island in Society archipelago are presented in Table 1 and
98 Figure2.

99 Over the study period we recorded 864 (63.7%) hospitalisations; among them, at least 270 (19.9%)
100 were in intensive care unit and 24 (1.8%) died.

101 Information on risk factors for leptospirosis was obtained from 920 (67.8%) cases for occupational
102 risk, 885 (65.3%) cases for leisure activity, 835 (61.6%) cases for contact with animals, and 324
103 (23.9%) cases for high risk facilities (Table 2).

104 **Discussion**

105 The worldwide AIR of leptospirosis is about 15 cases per 100,000 PY; the highest incidence is
106 reported in the Oceania region with 150 cases per 100,000 PY and a mortality rate of 9.6 per 100,000
107 PY. In this region AIR of up to 844 cases per 100,000 PY over an 11-year period from 2004 to 2014
108 has been reported in Futuna [25], with a pic of 1,945 cases per 100,000 PY in 2008 [4]. The AIR of
109 leptospirosis in FP between 2007 and 2017 was 46.0 (95%CI 43.6-48.5) cases per 100,000 PY, in the
110 lower range of AIR reported in the region (40-270) [13]. This incidence is low compared with other
111 Pacific Islands, probably because, at the difference of FP, most of them are low and middle income
112 countries. However, AIR of leptospirosis in FP is most probably underestimated, especially in the
113 most remote islands (Marquesas, Tuamotu Gambier and Austral). Main factors responsible for
114 underestimation of leptospirosis in FP are misdiagnosis with other diseases, especially dengue, a high
115 number of cases with few symptoms, and geographic constraint (isolation, multiplicity of islands, lack
116 of medical personnel to carry out sampling, difficulties in accessing health care facilities, lack of
117 transport or communication within and between islands) [26]. Similar clinical symptoms between
118 leptospirosis and arboviral infection is a main issue during arboviral outbreaks, leading to undetection
119 of leptospirosis cases and delayed treatment, potentially responsible for fatal cases [27].

120 Over the period 2007-2012 we noticed low variation of AIR. A peak of incidence was recorded in
121 2010. At the end of January 2010, cyclonic depressions (OLI hurricane) caused heavy rainfall and
122 mudslides in many FP islands, especially in Tahiti [22]. These exceptional climatic conditions led to
123 an increase in the number of cases in the first quarter of 2010. The population was quickly made aware
124 by the local health authority of the probable increase in the risk of leptospirosis. Health professionals
125 were encouraged to collect blood sample of patients with acute fever and diffuse pain syndrome. From
126 2013, the AIR increased due to an increase in screening linked to an arbovirus's epidemic context.
127 Dengue and Zika epidemics occurred simultaneously between September 2013 and March 2014,
128 followed by a major Chikungunya epidemic between October 2014 and March 2015 [28,29]. These 3
129 arboviruses are the main differential diagnoses of leptospirosis in endemic areas [11,27].
130 Concomitantly, the development of affordable molecular diagnosis in FP increased the number of tests
131 and then the number of diagnosed cases. The significant increase of AIR in 2017 is mainly related to
132 the heavy rains and floods at the beginning of the year [30].

133 Leptospirosis is known to be seasonal, and strongly associated with rainfall in tropical settings [9].
134 The number of cases increases during the hot and rainy season and decreases during the cold and dry
135 season [31,32]. Heavy rains and floods are associated with a six-fold increased risk of developing
136 leptospirosis and are a direct cause of epidemics as for the year 2017 in our cohort [31]. In FP, rainfall
137 usually increases from December with a peak in January and then decreases until April. In our cohort
138 60% of cases occurred during the first 5 months of the year, cases increased from January with a peak
139 in March and remains high until June. Thus, the recrudescence of reported cases of leptospirosis seems
140 to be delayed by 2 months compared with the peak rainfall. This phenomenon had already been
141 observed in Futuna and Reunion Island [25,33]. In two studies in Mayotte, cases followed the
142 evolution of rainfall with a three-month delay. According to the authors, the importance of seasonal
143 peaks is more related to the number of consecutive months with heavy rains than to the total rainfall
144 [34,35]. The discrepancy observed between the incidence of leptospirosis and peak rainfall is
145 explained by the soaking of the soil after the peak rainfall, which favour leptospire survival in the
146 environment [33,35].

147 We have found a geographical disparity in the incidence of leptospirosis in FP. AIR were higher in
148 high islands: Leeward Islands, Windward Islands and Marquesas. In contrast, lower islands (atolls) of
149 the Tuamotu-Gambier were almost free of cases due to their geomorphology: coral atolls without
150 relief and very little fresh water standing on the surface, no river or sludge because of the very porous
151 soils, and low rainfall. In the high islands, the development of agricultural and industrial operation,
152 and higher population density create waste and activities that may attract rodents and thus increase the
153 risk of contamination [31,32]. In the Society archipelago, AIRs are higher in some Windward Islands
154 and in the south-east part of Tahiti which are agricultural regions and where the main pig, cattle, horse
155 and poultry farms are located.

156 Most cases occurred in males, in accordance with what is described elsewhere. It probably only
157 reflects higher exposure of the male population through agricultural, farming and outdoor leisure
158 activities. The highest AIR was in the [20-29] year's old class. Like sex ratio, a high number of cases
159 in young age's classes possibly reflects a frequent exposure of young active men involved in
160 agriculture and farming activities. However, the hypothesis that older classes are relatively protected
161 by the immunity resulting from previous exposures also deserves consideration.

162 The main risk factor for leptospirosis in FP is professional or private agricultural activity: prevention
163 measures should target this population. Secondary risk factors are mostly recreational with fresh water
164 contact during leisure time (barefoot walking in mud, river bathing, hiking, gardening or fishing).
165 Other factors such as contact with rats, pigs as well as dogs (large population of stray dogs), leaving in
166 poor sanitary condition or in family farms in semi-urban areas near watercourses, can contribute to the
167 transmission of the disease [4,19].

168 **Conclusion**

169 Leptospirosis is a major public health concern in FP where it will become soon a reportable disease.
170 All laboratories and medical facilities, including intensive care unit, are available to diagnose and care
171 cases. Prevention includes guidelines for healthcare workers, prevention measures for the general
172 population broadcasted by a bi-monthly bulletin, and a reminder of the risk sent to the media after
173 each heavy rainfall or flooding. In addition, following the WHO One Health approach, collaboration
174 between animal and human health has been initiated to struggle against zoonosis as leptospirosis.
175 Enhancement of rodents control by the improvement of waste management is needed. Despite all
176 preventive measures, leptospirosis remains highly endemic in our country, highlighting the need to
177 maintain leptospirosis surveillance, medical staff training and information of the general population.

178

179 **Figures and tables**

180 **Figure 1a:** Leptospirosis cases and annual incidence rates in French Polynesia, 2007-2017

181 **Figure 1b:** Cumulated monthly cases of 11 years of leptospirosis in French Polynesia, 2007-2017

182 **Table 1:** Leptospirosis cases, annual incidence rates (AIR) and relative risks (RR) by islands of
183 Society archipelago, 2007-2017

184 **Figure 2:** Map of Society archipelago with a focus on Tahiti island, annual incidence rate of
185 leptospirosis by island and municipality, 2007-2017

186 **Table 2:** Potential risk factors of leptospirosis, French Polynesia, 2007-2017

187

188 **References**

- 189 [1] Haake DA, Levett PN. Leptospirosis in Humans. *Curr Top Microbiol Immunol* 2015;387:65.
190 doi:10.1007/978-3-662-45059-8_5.
- 191 [2] Torgerson PR, Hagan JE, Costa F, Calcagno J, Kane M, Martinez-Silveira MS, et al. Global Burden of
192 Leptospirosis: Estimated in Terms of Disability Adjusted Life Years. *PLoS Negl Trop Dis* 2015;9.
193 doi:10.1371/journal.pntd.0004122.
- 194 [3] Global Leptospirosis environmental action network. Mission - GLEAN-Leptospirosis 2018.
195 <https://sites.google.com/site/gleanlepto/website-builder>.
- 196 [4] Guernier V, Goarant C, Benschop J, Lau CL. A systematic review of human and animal leptospirosis in
197 the Pacific Islands reveals pathogen and reservoir diversity. *PLoS Negl Trop Dis* 2018;12.
198 doi:10.1371/journal.pntd.0006503.

- 199 [5] Kline K, McCarthy JS, Pearson M, Loukas A, Hotez PJ. Neglected tropical diseases of Oceania: review of
200 their prevalence, distribution, and opportunities for control. *PLoS Negl Trop Dis* 2013;7:e1755.
201 doi:10.1371/journal.pntd.0001755.
- 202 [6] Victoriano AFB, Smythe LD, Gloriani-Barzaga N, Cavinta LL, Kasai T, Limpakarnjanarat K, et al.
203 Leptospirosis in the Asia Pacific region. *BMC Infect Dis* 2009;9:147. doi:10.1186/1471-2334-9-147.
- 204 [7] Adler B, de la Peña Moctezuma A. *Leptospira* and leptospirosis. *Vet Microbiol* 2010;140:287–96.
205 doi:10.1016/j.vetmic.2009.03.012.
- 206 [8] Cerqueira GM, Picardeau M. A century of *Leptospira* strain typing. *Infect Genet Evol* 2009;9:760–8.
207 doi:10.1016/j.meegid.2009.06.009.
- 208 [9] Levett PN. Leptospirosis. *Clin Microbiol Rev* 2001;14:296. doi:10.1128/CMR.14.2.296-326.2001.
- 209 [10] World Health Organization. Human leptospirosis: guidance for diagnosis, surveillance and control.
210 Geneva: World Health Organization; 2003.
- 211 [11] Bharti AR, Nally JE, Ricaldi JN, Matthias MA, Diaz MM, Lovett MA, et al. Leptospirosis: a zoonotic
212 disease of global importance. *Lancet Infect Dis* 2003;3:757–71.
- 213 [12] World Health Organization. WHO | Managing epidemics. WHO 2018.
214 <http://www.who.int/emergencies/diseases/managing-epidemics/en/>.
- 215 [13] Costa F, Hagan JE, Calcagno J, Kane M, Torgerson P, Martinez-Silveira MS, et al. Global Morbidity and
216 Mortality of Leptospirosis: A Systematic Review. *PLoS Negl Trop Dis* 2015;9.
217 doi:10.1371/journal.pntd.0003898.
- 218 [14] Ahmed A, Grobusch MP, Klatser PR, Hartskeerl RA. Molecular Approaches in the Detection and
219 Characterization of *Leptospira*. *J Bacteriol Parasitol* 2011;3. doi:10.4172/2155-9597.1000133.
- 220 [15] Lau C. Combating infectious diseases in the Pacific Islands: sentinel surveillance, environmental health,
221 and geospatial tools. *Rev Environ Health* 2014;29:113–7. doi:10.1515/reveh-2014-0028.
- 222 [16] Musso D, La Scola B. Laboratory diagnosis of leptospirosis: a challenge. *J Microbiol Immunol Infect Wei*
223 *Mian Yu Gan Ran Za Zhi* 2013;46:245–52. doi:10.1016/j.jmii.2013.03.001.
- 224 [17] WHO | Leptospirosis Burden Epidemiology Reference Group (LERG). WHO 2010.
225 <http://www.who.int/zoonoses/diseases/lerg/en/> (accessed August 2, 2018).
- 226 [18] Décret du n° 2017-1681 du 13 décembre 2017 authentifiant les résultats du recensement de la population
227 2017 de Polynésie française. 2017.
- 228 [19] Guernier V, Richard V, Nhan T, Rouault E, Tessier A, Musso D. *Leptospira* diversity in animals and
229 humans in Tahiti, French Polynesia. *PLoS Negl Trop Dis* 2017;11:e0005676.
230 doi:10.1371/journal.pntd.0005676.
- 231 [20] Heuls J. [Leptospirosis caused by *Leptospira icterohemorrhagiae* in Tahiti]. *Bull Soc Pathol Exot Filiales*
232 1959;52:22–6.
- 233 [21] Berry A, Mallet H-P, Pescheux J. Situation épidémiologique de la leptospirose en Pf (2006-2012). *Bull*
234 *D'informations Sanit Épidémiologiques Stat* 2013;4–6.
- 235 [22] Daudens E, Frogier E, Mallet H-P. Recrudescence of leptospirosis in French Polynesia in early 2010.
236 *Inform'Action* 2010:3–6.
- 237 [23] Hirschauer C. Épidémiologie de la leptospirose en Polynésie française de 2006 à 2008. *Bull*
238 *Épidémiologique Hebd* 2009:4.

- 239 [24] Institut de la statistique de Polynésie française 2018. <http://www.ispf.pf/>.
- 240 [25] Massenet D, Yvon J-F, Couteaux C, Goarant C. An Unprecedented High Incidence of Leptospirosis in
241 Futuna, South Pacific, 2004 – 2014, Evidenced by Retrospective Analysis of Surveillance Data. PLOS
242 ONE 2015;10:e0142063. doi:10.1371/journal.pone.0142063.
- 243 [26] Coudert C, Beau F, Berlioz-Arthaud A, Melix G, Devaud F, Boyeau E, et al. [Human leptospirosis in
244 French Polynesia. Epidemiological, clinical and bacteriological features]. *Med Trop Rev Corps Sante*
245 *Colon* 2007;67:137–44.
- 246 [27] Nhan T-X, Bonnieux E, Rovey C, De Pina J-J, Musso D. Fatal leptospirosis and chikungunya co-
247 infection: Do not forget leptospirosis during chikungunya outbreaks. *IDCases* 2016;5:12–4.
248 doi:10.1016/j.idcr.2016.06.003.
- 249 [28] Aubry M, Teissier A, Huart M, Merceron S, Vanhomwegen J, Roche C, et al. Zika Virus Seroprevalence,
250 French Polynesia, 2014–2015. *Emerg Infect Dis* 2017;23:669–72. doi:10.3201/eid2304.161549.
- 251 [29] Cao-Lormeau V-M, Roche C, Teissier A, Robin E, Berry A-L, Mallet H-P, et al. Zika virus, French
252 polynesia, South pacific, 2013. *Emerg Infect Dis* 2014;20:1085–6. doi:10.3201/eid2006.140138.
- 253 [30] Bureau de Veille Sanitaire. La leptospirose en Polynésie française Rapport annuel 2017. 2018.
- 254 [31] Mwachui MA, Crump L, Hartskeerl R, Zinsstag J, Hattendorf J. Environmental and Behavioural
255 Determinants of Leptospirosis Transmission: A Systematic Review. *PLoS Negl Trop Dis*
256 2015;9:e0003843. doi:10.1371/journal.pntd.0003843.
- 257 [32] Lau CL, Watson CH, Lowry JH, David MC, Craig SB, Wynwood SJ, et al. Human Leptospirosis Infection
258 in Fiji: An Eco-epidemiological Approach to Identifying Risk Factors and Environmental Drivers for
259 Transmission. *PLoS Negl Trop Dis* 2016;10:e0004405. doi:10.1371/journal.pntd.0004405.
- 260 [33] Desvars A, Jégo S, Chiroleu F, Bourhy P, Cardinale E, Michault A. Seasonality of human leptospirosis in
261 Reunion Island (Indian Ocean) and its association with meteorological data. *PloS One* 2011;6:e20377.
262 doi:10.1371/journal.pone.0020377.
- 263 [34] Lernout T, Bourhy P, Achirafi A, Giry C, Picardeau M. Epidemiology of human leptospirosis in Mayotte :
264 an emerging public health problem on the island? *Arch Inst Pasteur Madag* 2013.
- 265 [35] Pagès F, Collet L, Margueron T, Achirafi A, Bourhy P, Picardeau M, et al. Leptospire à Mayotte :
266 apports de la surveillance épidémiologique, 2008-2015. *Bull Epidemiol Hebd* 2017.
- 267

Figure 1a: Leptospirosis cases and annual incidence rates in French Polynesia, 2007-2017

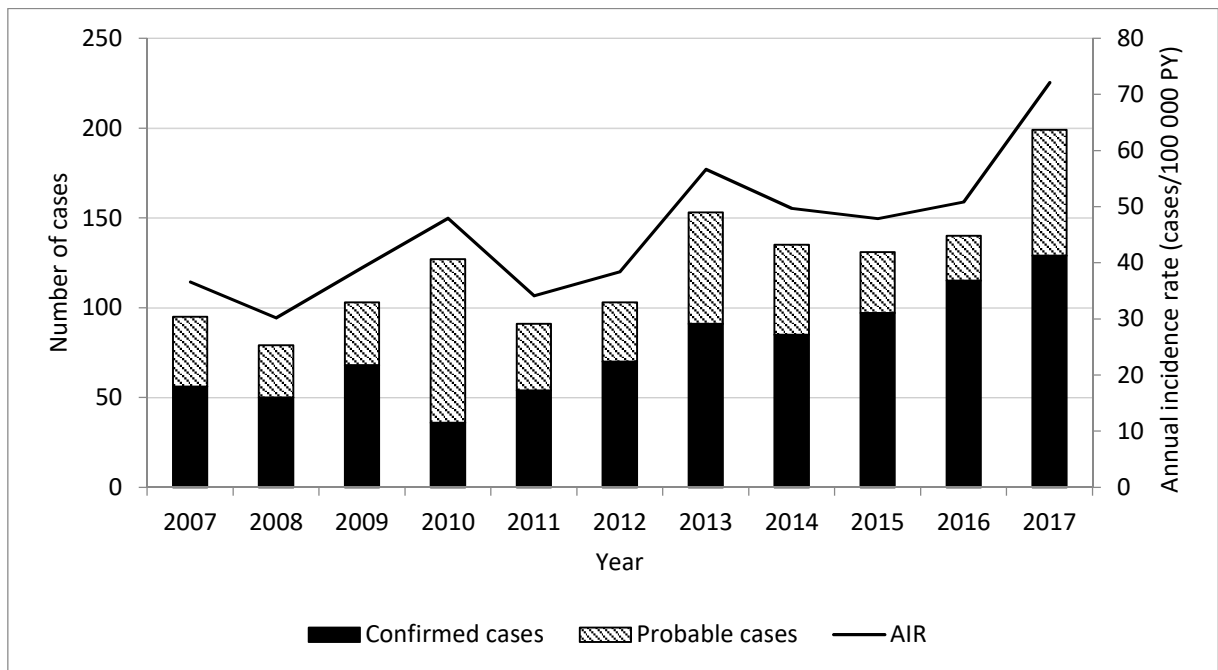
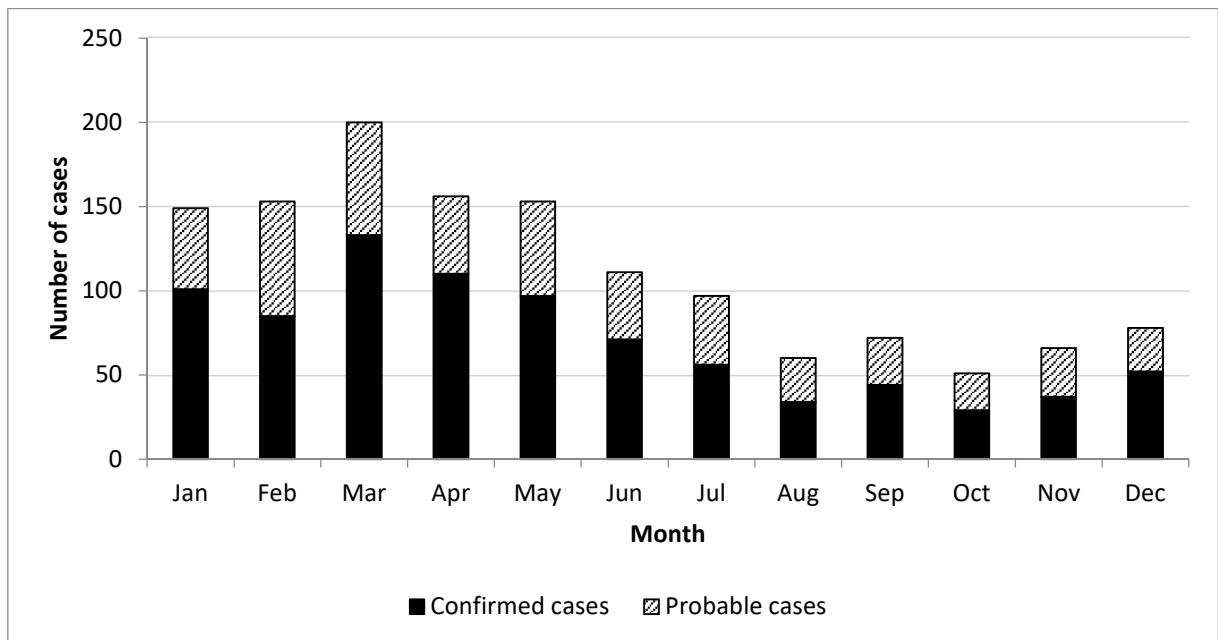


Figure 1b: Cumulated monthly cases of 11 years of leptospirosis in French Polynesia, 2007-2017



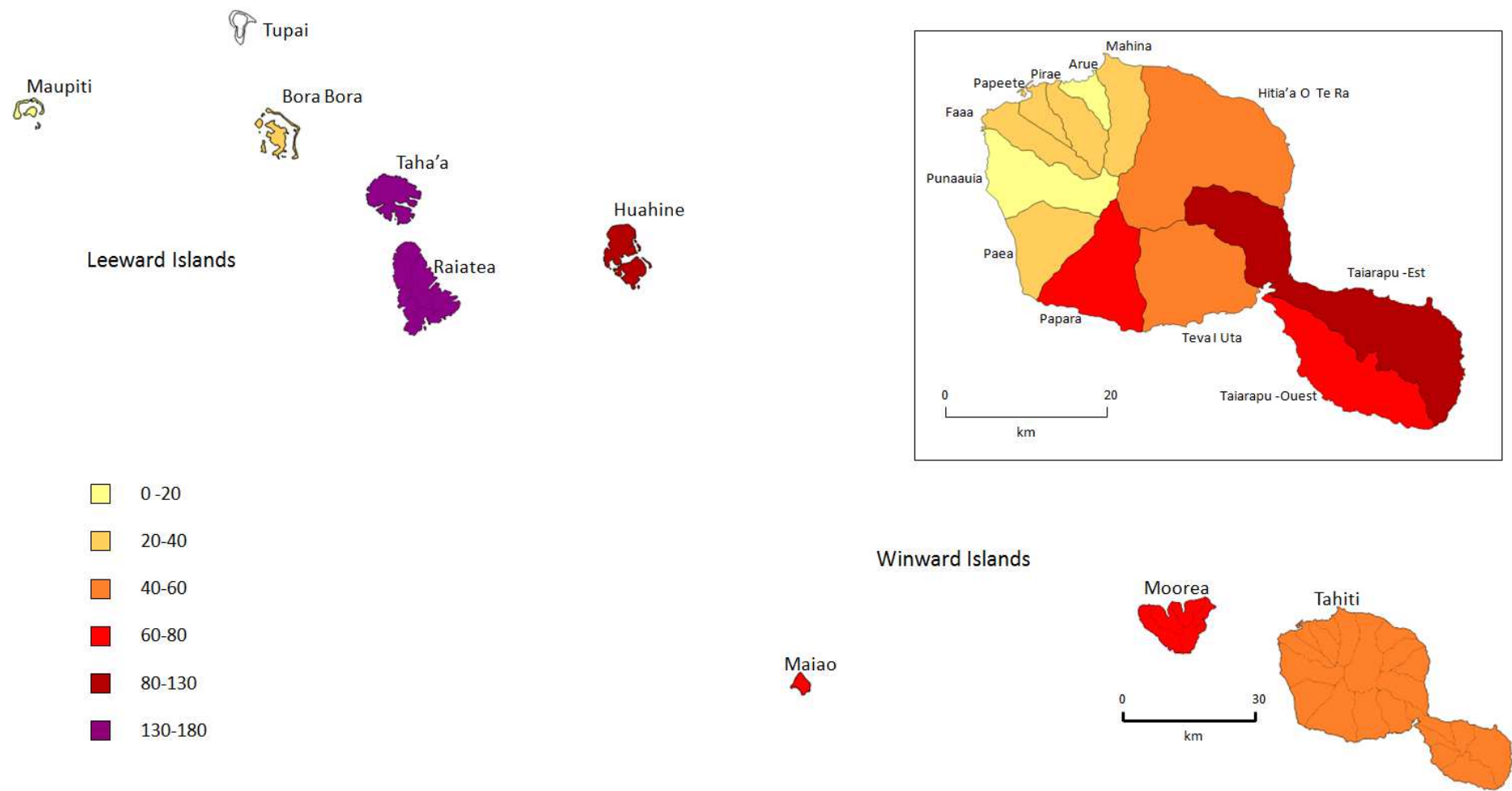


Figure 2: Map of Society archipelago with a focus on Tahiti island, annual incidence rate of leptospirosis by island and municipality, 2007-2017

1 **Table 1:** Leptospirosis cases, annual incidence rates (AIR) and relative risks (RR) by island of Society
 2 archipelago, 2007-2017

Islands	n (%)	AIR ^a (IC95%)	RR (IC95%)	p ^b
Tahiti	731 (57.9)	40.0 (37.1-43.0)	1.00 (reference group)	
Moorea - Maiao	121 (9.6)	63.8 (53.0-76.3)	1.6 (1.3-1.9)	<0.001
Raiatea	191 (15.1)	141.9 (132.3-163.5)	3.6 (3.0-4.2)	<0.001
Tahaa	94 (7.5)	163.7 (132.3-200.4)	4.1 (3.3-5.1)	<0.001
Huahine	87 (6.9)	125.5 (100.5-154.8)	3.1 (2.5-3.9)	<0.001
Bora-Bora	37 (2.9)	35.1 (24.7-48.3)	0.9 (0.6-1.2)	0.437
Maupiti	1 (0.1)	7.6 (0.2-42.4)	0.2 (0.03-1.4)	0.098

^aAIR : Annual Incidence Rate in number of cases per 100,000 persons year

^bComparison of relative risk with the reference group.

3 **Table 2:** Potential risk factors of leptospirosis, French Polynesia, 2007-2017

Category		Number of cases	Percentage over the total number of cases provided for this category	Missing values for this category	
Occupational risk	Farmer	383	41.6%		
	Sanitation and waste treatment	60	6.5%		
	Animal husbandry	134	14.6%	436	32.2%
	Cattle breeding	23	2.5%		
	Horse breeding	17	1.8%		
	Pig farming	43	4.7%		
Leisure activity / fresh water contact	Fishing	131	14.8%		
	Hunting	40	4.5%		
	Gardening	319	36.0%		
	Hiking	101	11.4%	471	34.7%
	Walking barefoot	497	56.2%		
	Fresh water swimming	277	31.3%		
Contact with animals	River mouth surfing	67	7.6%		
	Cats	292	35.0%		
	Dogs	466	55.8%	521	38.4%
High risk facilities	Rats	545	65.3%		
	Dump in the vicinity	126	38.9%	1032	76.1%
	Water abstraction	48	14.8%		