The role of surfers in beach safety management: Insights from French respondents to a global surfer survey

Jeoffrey Dehez, Bruno Castelle, David Carayon, Amy E Peden, Robert W Brander

Ocean and Coastal Management 248 (2024) 106973

Contents lists available at ScienceDirect

Ocean and Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

The role of surfers in beach safety management: Insights from French respondents to a global surfer survey

Jeoffrey Dehez [a,e,*], Bruno Castelle [b,e], David Carayon [a], Amy E. Peden [c,e], Robert W. Brander [d,e]

[a] INRAE Nouvelle Aquitaine Bordeaux, Gazinet, France
[b] Univ. Bordeaux, CNRS, Bordeaux INP, EPOC, UMR 5805, F-33600, France
[c] School of Population Health, Faculty of Medicine and Health, UNSW Sydney, Sydney, Australia
[d] School of Biological, Earth and Environmental Sciences, UNSW Sydney, Sydney, Australia
[e] UNSW Beach Safety Research Group, UNSW Sydney, Sydney, Australia

ARTICLE INFO

Keywords:
Drowning prevention
Rescue
Beach safety
Recreational surfing
Coastal natural hazards management

ABSTRACT

Coastal locations are a leading contributor to the global drowning burden. Despite being a known risk-reduction measure, a significant proportion of beachgoers continue to bathe outside of lifeguard-patrolled areas placing themselves at increased risk of beach hazards such as rip currents and breaking waves. Under such conditions, recreational surfers represent a potentially important role as bystander rescuers although little is known about surfers' relationship to safety. In this study, we analyze surfer beach safety knowledge and behaviors using a sample of 569 French surfers, drawn from a Global Surfer Survey. Using pair wised comparisons and multivariate analysis, surfer characteristics as rescuers and as victims are investigated as well as their willingness to learn new safety skills. In our survey, 55.9% of French surfers self reported having previously conducted a rescue. We show that experienced and highly skilled surfers have a higher probability of performing a rescue than other surfers, but having completed ocean lifeguard training has no statistical influence. Having previously experienced injury seems beneficial both to act as a rescuer, but also in improving a surfers own safety. As victims, surfers appear to be calmer and less often in trouble with rip currents as others, such as swimmers. Compared to non surfers, surfers were less likely to be able to walk away and more likely to require medical assistance nevertheless. In the survey, 88.4% of the respondents were willing to take part in a course aimed at lifesaving and rescue skills for surfers, whether freely provided or not. Younger surfers (under 24 years) are more willing to acquire formal safety skills than other age groups. On the contrary, having already performed a rescue has no statistical influence on the willingness to attend training sessions. Despite the significant involvement of surfers in saving lives in the coastal environment, there remains a need to encourage collaboration between local surfers and other stakeholders officially in charge of beach safety management.

1. Introduction

Drowning is one of the leading causes of unintentional injury-related death globally (WHO 2014), and coastal locations are a significant contributor to the global drowning burden (Koon et al., 2021). Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid. Depending on the severity, outcomes range from exhaustion with no sign of water inhalation to cardiac arrest and death (van Beeck et al., 2005). Drowning on surf beaches, often caused by rip currents, has received increased attention in recent years (Castelle et al., 2015; Brander and Scott 2016, Brewster et al., 2019). Rip currents are strong, narrow seaward flowing currents that extend from the shoreline and through the surf zone and represent a significant hazard to bathers and swimmers (Castelle et al., 2016). On beaches, the most common and effective management measure to reduce drowning risk is designating bathing areas which are supervised by experienced lifeguards (Gilchrist and Branche 2016). However, it is often not possible due to logistic constraints to supervise entire stretches of coastline and it is common for many bathers to swim outside of lifeguard patrolled areas and beaches without lifeguards, thus increasing drowning risk (Wilks et al., 2007; Uebelhoer et al., 2022).

Under these conditions, rescues conducted by bystanders are critical to beach safety (Franklin and Pearn 2011, 2014; Pearn and Franklin 2012). In general terms, a bystander rescue is defined as a rescue of

* Corresponding author. INRAE Nouvelle Aquitaine Bordeaux, Gazinet, France.
E-mail address: Jeoffrey.dehez@inrae.fr (J. Dehez).

https://doi.org/10.1016/j.ocecoaman.2023.106973
Received 2 May 2023; Received in revised form 21 September 2023; Accepted 3 December 2023
Available online 15 December 2023

someone in distress that is carried out by one or more members of the public acting in a non-professional capacity, generally spontaneously and altruistically. Although bystander rescues are difficult to quantify, several recent studies have shown that they occur regularly (Brander et al., 2019; Franklin et al., 2019). However, bystanders can also drown while attempting a rescue (Zhu et al., 2015; Lawes et al., 2020).

Surfers have previously been shown to serve an important role as bystander rescuers (Attard et al., 2015; Berg et al., 2021; De Oliveira et al., 2023; Mead et al., 2023). Today, surfing is a very popular activity globally (Martin and Assenov 2012; Hritz and Franzidis 2018). Surfing is the sport of riding waves in an upright or prone position using boards of various designs, or even just bodysurfing. Surfers are often in the water all year round, at times or places where there is no lifeguard supervision. They are skilled in identifying rip currents (using them to paddle out under heavy waves), understand the coastal environment more broadly and have a flotation device (their surfboard) at hand. Surfboards come in different styles, shapes, and sizes (Fig. 1). Depending on their length, surfboards are either longboards (at least 9 feet long) or shortboards (6 feet on average). Unlike surfing, bodyboarding is generally practiced on a smaller foam board in a prone position. Recently, stand-up paddling has become much more popular: in this particular case, surfers no longer paddle lying down before getting up on the wave, they stand up most of the time and move around using a paddle.

Most studies on bystander rescues by surfers have focused on the positive influence of surfing experience on the ability to perform a rescue, indicating that the most experienced and technically skilled surfers were more likely than others to perform a rescue (Attard et al., 2015; Berg et al., 2021; De Oliveira et al., 2023; Mead et al., 2023). By comparison, the influence of lifesaving skills on the likeliness to perform a rescue is more ambiguous. While Attard et al. (2015) have shown that Australian surfers with lifesaving knowledge and experience were more likely than others to perform rescues, De Oliveira et al. (2023) have highlighted the very low level of lifesaving and resuscitation skills expressed by surfers who performed a rescue in Portugal and Spain. Similar conclusion hold in Mead et al. (2023) in Aotearoa, New Zealand. This is possibly due to the potential impact of cultural and institutional factors on safety behaviours as well as the availability of programs and courses designed to teach surfers rescue skills (Attard et al., 2015; Berg et al., 2021). Although all the studies agree on the need to improve the skills of rescuers, little is known about the most appropriate way of disseminating information. Berg et al. (2021) have shown that surfers currently favor online websites or social networks to search for information about how to stay healthy and safe while surfing. However, although surfing is acknowledged as an inherently risky activity (Thom et al., 2022), little is known about surfers' relationship to safety.

Building upon other studies of surfer rescuers such as Berg et al. (2021), the aim of this study is to improve existing understanding of the role that surfers play as bystander rescuers by exploring surfers' competencies and skills that are used when they conduct a rescue. Our analysis is based on data collected by the online Global Surfer Survey and comprises a sample of French surfers. We analyze the characteristics of surfers as rescuers, but also as drowning victims, before studying their willingness to learn new safety skills and discussing their potential role in beach safety management. If surfers are to be fully integrated into a holistic approach to global beach safety management, it is important to better understand the ways they operate, the skills they use and those they still need to acquire.

2. Methods

2.1. Study setting

France has a coastline extending over 5000 km, excluding oversea territories, and coastal regions are important for recreational activities and tourism (Rulleau et al., 2012; Le Corre et al., 2021). The French coastline stretches along three maritime coasts: the Atlantic Ocean in the West, the English Channel and the North Sea in the North, and the Mediterranean Sea in the South (Fig. 2). Most of the Atlantic coast of France is a popular surfing destination as it is exposed to energetic swells generated in the North Atlantic Ocean with long stretches of open beach breaks alternating with reefs and point beaks, thus offering ridable waves throughout the year. In contrast, the English Channel and North Sea coasts typically require more energetic waves from the North Atlantic, and the Mediterranean coast offers ridable waves mostly in autumn and winter during occasional, short-lasting, short-period waves.

In France, bathing is supervised by lifeguards on a large number of beaches, but the supervision period is mostly limited to the summer months (July and August). The French public health authorities recorded around 1500 unintentional drownings, of which 633 occurred in coastal areas in 2021. The drownings recorded by this database refer to the most serious cases, i.e. when the victim has inhaled water and has suffered from respiratory impairment or even cardiac arrest (Ung et al., 2022). In coastal areas, 28% of total drownings (i.e. 176) result in a fatality and 51% of all drowning incidents (both fatal and non-fatal) occurred at supervised beaches, compared to 49% in unsupervised beaches.

Surfing started in France in the 1960s. Today, surfing in France is an activity involving approximately 700,000 surfers distributed throughout metropolitan France and overseas territories (www.surfingfrance.fr). The National French Surfing Federation (*Fédération Française de Surf*, i.e. FFS) has received delegation of responsibilities from the French Ministry of Youth and Sports in order to organize, develop and regulate surfing activities (https://www.surfingfrance.com/). As in many countries, recreational surfing is conducted outside of any organizational settings, i.e., with family and friends. It is estimated that amongst the 700,000 French surfers only 18,000 are members of the FFS.[1] In 2015, FFS initiated training sessions on specific first aid techniques for surfers as part of a national program called "Surfeurs Sauveteurs" (Savers Surfers). A few years later, FSS launched an exploratory survey on rescues performed by French surfers (Fédération Française de Surf, 2019). Among the 1365 valid questionnaires the majority of surfers were members of the National Federation. In this sample, 54% of the respondents self-reported having performed at least one rescue in the last 10 years.

2.2. Survey design

Study data were collected through the Global Surfer Survey (GSS), which was developed by the UNSW Beach Safety Research Group (UNSW BSRG) in Australia, and further refined for international application by members of the International Drowning Researchers Alliance (IDRA), the National Research Institute for Agriculture, Food and Environment (INRAE), Université de Bordeaux and the National Centre for Scientific Research (CNRS) in France. The survey is hosted on the Qualtrics software platform and was made available via https://www.beachsafetyresearch.com/gss in December 2021. The GSS is designed to gather information on surfer demographics and surfing experience, their experience and opinions regarding surf injuries, participation in lifesaving courses and conducting rescues, and their opinions on a range of environmental and coastal management issues.

Question 20 of the survey asked '*As a surfer, have you ever rescued someone while surfing*? and if participants answered '*Yes*', they were directed to a series of questions on their experience(s) rescuing people while surfing as bystanders, outside of any professional rescue capacity. Respondents were then asked detailed questions about their most recent rescue. Depending on whether participants had performed a rescue or not, the survey consists of between 32 and 56 questions and takes approximately 15–25 min to complete online. An English and French

[1] Having a licence is not mandatory to surf. The license provides insurance against accidents and allows you to benefit from the services offered by the federation. It is compulsory for competitors and coaches.

Fig. 1. Different types of surfing and associated flotation devices: (a) surfer riding a short board; (b) surfer riding a longboard; (c) bodyboarder; and (d) surfer riding a stand up paddle board (sources: Wikicommons & World Surf League).

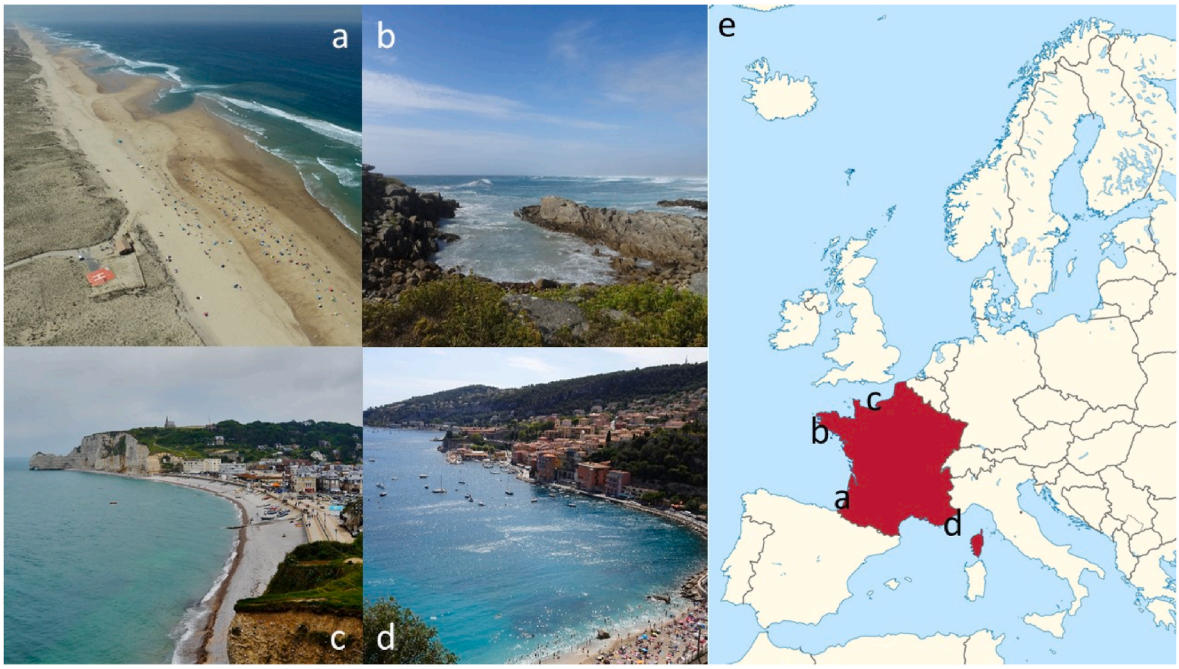

Fig. 2. Examples of French coastlines: (a) and (b) show sandy and rocky beaches on the West Atlantic coast; (c) presents cliffs along the Manche – North Sea coast; (d) presents cliffs and rocky beach along the Mediterranean coast; (e) presents location of France in Europe; coastal pictures have been geographically located in panel e (sources: Wikicommons, Vincent Marieu & Jeoffrey Dehez).

version of the survey is provided in the Supplementary File 1.

To take part in the survey, participants must be 18 years of age or older and consider themselves to be a surfer and/or have surfing experience. The survey received Ethics Approval from the UNSW Sydney Human Research Ethics Committee (#HC210836). This study uses data obtained from the French language version of the survey only, which was specifically promoted with the support of the French National Surfing Federation (FSS), French surfing online magazines and French surfing social networks. Each of the partners has included a permanent web link to the Global Surfer Survey website on their own website. An official announcement was made at the time of the launch of the survey, with several reminders on social networks until the database was extracted on 31 March 2022.

2.3. Data analysis

A total of 713 survey responses from the French version of the GSS were extracted on 31 March 2021 from Qualtrics. In this study, we focus

on respondents from metropolitan France, excluding overseas and foreign territories. After excluding empty or incomplete surveys, 569 surveys remained for analysis. In addition to the questions related to the surfers, surfers provided data on 259 unique rescues. We performed descriptive statistical analyses to describe our sample and characterize survey's participants as well as rescues. Following Attard et al. (2015) we performed pair wise comparisons with Chi-square tests of significance to identify the conditions most often associated with a rescue. As in Berg et al. (2021) we estimated multivariate logistic regression models to predict bystander rescue by surfers and willingness to acquire new knowledge. Models' predictors include socio-demographics (gender, age), surfing experience (number of years of surfing, technical level), having being injured or not and four additional variables describing several available options to acquire formal safety information.

The role of lifesaving training and first aid knowledge has already been highlighted in several publications (Attard et al., 2015; Brander et al., 2019; Berg et al., 2021). The introduction of variables on surfing lessons or membership of the national surfing federation is more specific to the French case. These are two proven opportunities for information to be disseminated to surfers. Finally, although surfers' exposure (i.e. long time spent in the water) can be hypothesized to increase their chances of performing a rescue, to our knowledge it has not been verified in any scientific study. In an attempt to explore this hypothesis, we introduced two variables likely to shed light on this (i.e. frequency and duration of surfing session). We calculated Odd Ratios (OR) with 95% confidence intervals for predictors selected in the regression models. To estimate the models, we used the GLM and MULTINOM functions from STATS and NNET packages included in R software (R Core Team 2019).

3. Results

3.1. Sample statistics

Respondents are located all through metropolitan Fance and along the French coastline, with the largest number of respondents living in the south-west (Fig. 3). Some respondents live inland and probably only surf during their holidays. Rescue responses are distributed over the three coasts, with the largest numbers on the Atlantic coast. This spatial distribution of our surfer population is in line with the consistent surfing conditions along the Atlantic coast resulting in a large number of surfers. In addition, the hazardous surf zone conditions with strong rip currents and sometimes shore-break waves (Castelle et al., 2019) also maximize the probability for surfers to perform rescues.

Survey respondents were mostly male (80.8%) of all ages (Table 1), and most surf shortboards (58.7%). Respondents were relatively experienced with 35.4% declaring more than 20 years of surfing. Two-thirds described themselves as having an "advanced" level, i.e. being able to surf unbroken waves left and right, turn on the wave, stay close to the breaking part and control bottom and top turns (see Supplementary File 1). Two-thirds of the respondents (68.7%) surf once or twice a week or less and 66.7% spend an average of 2 h in the water. The surfer respondents rarely surfed alone. Two-thirds of the respondents (66.0%) lived less than 30 min away from the beach by car.

One respondent out of five (19.4%) declared that they were members of the French Surfing Federation. One in every two respondents (53.6%) had taken formal surfing lessons. Almost half of all respondents (49.2%) in the sample declared that they have had civil first aid training and about a quarter (23.9%) had completed French National ocean lifesaving training. Taking into account multiple responses, 70.9% of respondents reported having participated in at least one first aid course. Of these however, only 35.7% of respondents had a current qualification.

In our sample, 55.9% of respondents indicated that they had rescued someone while surfing. Of these, almost half (47%–26.3% of total sample) had performed a rescue over the last 12 months. Most rescuees (72.8%) were male (Table 2) and 36.9% were aged between 20 and 30 years. Four out of ten panicked (38.8%) and/or were exhausted (42.5%) at the time of rescue. More than a third (37.7%) felt well and were able to walk away after having been rescued. More than half of the rescued individuals (54.5%) were swimming, 32.1% were surfing and 7.5% were bodyboarding prior to being rescued.

Regarding the circumstances of the rescues (Table 3), the majority of incidents took place during sunny and fine days (64.4%). Respondents stated that three quarters (74.4%) of their rescues took place either where no lifeguards were present or outside of lifeguard patrol hours. Two-thirds (66.1%) of the incidents where a rescue was made were associated with the presence of a rip current according to the respondents.

In most cases (84.8%), the surfer spotted the person(s) in trouble and volunteered to help. None of the surfers indicated that they had responded to a request from the lifeguards to perform a rescue. Although not shown in Table 3, it should also be noted that surfers used their board as a rescue tool in 69.9% of cases. In 46.3% of the rescues, the surfer was assisted by other surfers.

3.2. Characteristics of surfers as rescuers

As in Berg et al. (2021), we modeled the probability for a surfer to perform a rescue using binomial logistic regression (Table 4).

There was no impact on the odds of self-reporting rescuing someone between genders. A surfers age also did not have a significant influence on the probability of performing a rescue. Compared to people with less than five years of experience, respondents with more than 20 years of surfing experience had almost four times (OR = 3.5 CI = 1.5–8.9 $P < 0.01$) the likelihood of self-reporting having rescued someone. Being an "advanced" or a "pro" surfer, having been injured in the past, and being a member of the French National Surfing Federation increase by factors of 2.1 times (OR = 2.1 CI = 1.1–4.2 $P < 0.05$), 3.5 times (OR = 3.5 CI = 1.9–6.8 $P < 0.01$) and 2.6 times (OR = 2.6 CI = 1.4–4.9 $P < 0.01$) the odds of self reporting a rescue respectively. Compared to people who surf less than once a month, respondents who declare they surf more than 5 times a week had more than 3 times (OR = 3.4 CI = 1.3–9.0 $P < 0.01$) the odds of having rescued someone. On the contrary, having received formal surfing lessons decreased the odds (OR = 0.6 CI = 0.6–1.6 $P < 0.1$) of performing a rescue, although the relationships holds at 10% level significance only.

3.3. Characteristics of surfers as victims

In our sample, 81.9% of respondents declared that they had previously sustained an injury while surfing (Table 5) with almost half (46.2%) reporting they had previously had a minor injury (i.e. no doctor involved; self-treated) and 35.6% of respondents had to visit a doctor or seek medical attention. The probability of reporting an injury while surfing was statistically related to gender ($\chi^2_{(1)} = 15.24$; $P < 0.01$) and age ($\chi^2_{(4)} = 26.38$; $P < 0.01$). Women and people aged 56 years and older were significantly less likely than others to self-report having been injured previously. Surfers between 18 and 24 years were significantly less likely than others to have been severely injured.

Additional information on surfers' exposure to injury can be found in the analysis of rescue characteristics. A Chi-square test of independence found a significant relationship between the activity prior to the rescue with behavior, severity, and the presence of a rip current. Regarding outcome and severity, surfers appear to be calmer ($\chi^2_{(1)} = 5.8895$; $P < 0.05$) and more aware of the danger ($\chi^2_{(1)} = 3.39841$ $P < 0.1$) compared to non-surfers.[2] Surfers were less likely to be able to walk way ($\chi^2_{(1)} = 3.838$; $P < 0.1$) and more likely to require medical requirement ($\chi^2_{(1)} =$

[2] Due to the distribution of responses on activities, some numbers were too small to perform statistical tests. We therefore chose to put all non-surfers (i.e. swimmers, bodyboarders, others) in the same group.

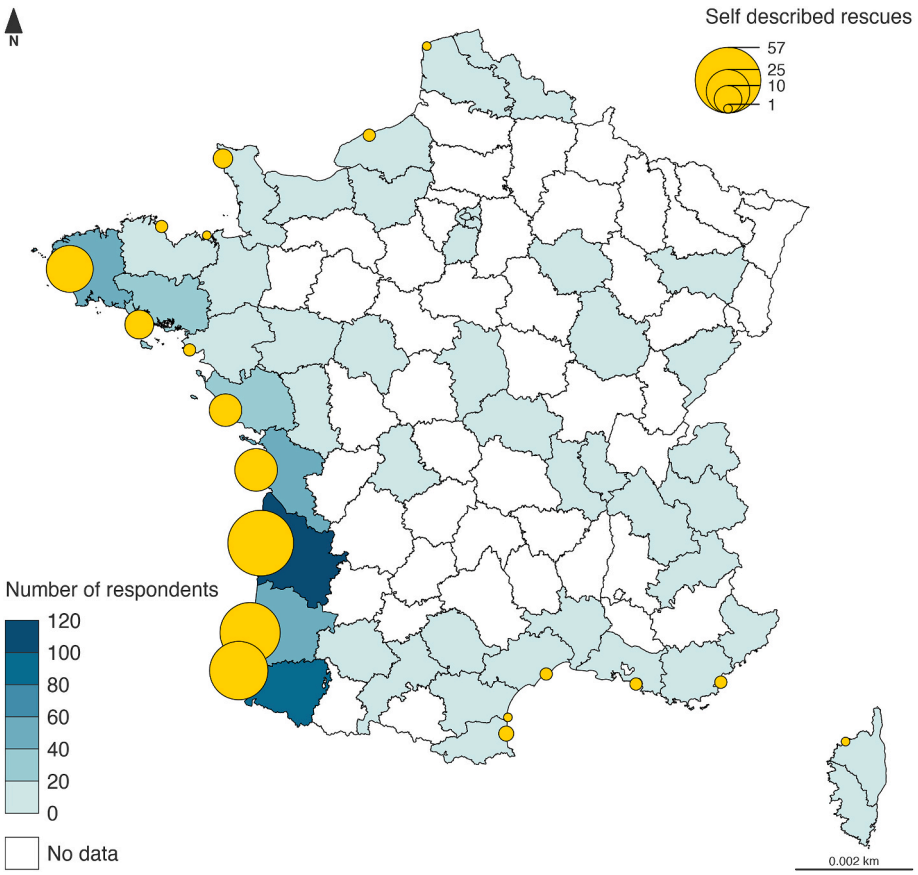

Fig. 3. Spatial distribution of the residence location within France of respondents (n = 569) to the Global Surfer Survey. Survey responses with incomplete data are not included.

12.3986, P < 0.01). In our sample, surfers were less often in trouble with rip currents than others, such as swimmers ($\chi^2_{(1)} = 36.23751$, P < 0.01).

3.4. Surfers' willingness to attend to rescue training

In the sample, a large majority of surfers stated that they "somewhat agree" (26.9%), "agree" (22%) or "strongly agree" (39.6%) with the statement that surfers have a responsibility to look after the safety of others. A majority of surfers also "somewhat agree" (34.8%), "agree" (17.4%) or "strongly agree" (29.5%) with the idea that all surfers should complete a basic lifesaving course. In addition, 64.9% of the respondents were willing to take part in a free course aimed at lifesaving and rescue skills for surfers, 23.5% were willing to pay for it, and 11.6% were not interested in attending either a paid or free course. Because of the categorical nature of the data (i.e. "not interested"/"yes if free of charge"/"yes and I would pay") we estimated a multinomial logistic model (Table 6). The reference level is the "no interest" response. The explanatory variables are the same as those used in the previous binomial regression except for the frequency and duration of surfing sessions. As in Berg et al. (Berg et al., 2021) we tested the hypothesis that having carried out a rescue was likely to influence attitudes towards training. To do this, we introduced a dichotomous variable indicating whether or not the individual had performed a rescue in the model.[3]

Unlike the previous models described in Table 4, age had a significant influence on the responses. Compared to the reference level, older surfers had less interest in attending lifesaving courses, regardless of whether the course was free of charge. Compared to surfers in the 18–24 age group (reference level), surfers aged between 36 and 45, 46 and 55 and over 56 respectively have a 84% (OR = 0.16, CI = 0.04–0.55, P < 0.01), 86% (OR = 0.14, CI = 0.03–0.54, P < 0.01) and 93% (OR = 0.07, CI = 0.14–0.37, P < 0.01) decrease in the odds of willingness to take part in a free training course. Similar results were evident with the fee-based training. Compared to surfers in the 18–24 age group, surfers aged between 25 and 35, 36 and 45, 46 and 55 and over 56 respectively have a 74% (OR = 0.16, CI = 0.04–0.55, P < 0.05), 91% (OR = 0.09, CI = 0.02–0.37, P < 0.01), 85% (OR = 0.15, CI = 0.03–0.65, P < 0.05) and 91% (OR = 0.09, CI = 0.01–0.55, P < 0.01) decrease in the odds of willingness to take part in a fee based training course.

Not surprisingly, individuals who had already received training were less interested than others to take further training, even if courses were free of charge (OR = 0.29, CI 0.14–0.59, P < 0.01). Compared to non-members, members of the National Surfing Federation were three times more willing to pay for a lifesaving course (OR = 3.15, CI = 1.10–9.02, P < 0.05). Unlike the model associated with conducting a rescue, neither surfing experience, technical level, nor previous experience of an injury had a significant influence on the odds of intention to participate in training, whether freely provided or not. Having performed a rescue operation does not change the chances of accepting a training course either.

4. Discussion

Recent studies have shown that the bystander rescue phenomenon is far more important than previously thought (Brander et al., 2019; Franklin et al., 2019). In our survey, 55.9% of French surfers

[3] Indeed, the frequency of surfing sessions is correlated with the probability of having performed a rescue. We estimated the model with the frequency and duration variables, without observing any major change. For ease of reading, we did not include this version of the model in the article. Results are available on request.

Table 1
Descriptive statistics for surfer sample (N = 569).

Question	Response	%	N
Gender	Male	80.8	460
	Female	19.2	109
Age	18–24	26.9	153
	25–35	26.4	150
	36–45	23.6	134
	46–55	18.0	102
	56–65	4.2	24
	65 or older	0.9	5
Type of surfing	Short board	58.7	334
	Long board	25.0	142
	Bodyboard	6.5	37
	Bodysurf	2.6	15
	Stand up paddle	3.7	21
	Other	3.5	20
Number of years surfing	<5 years	22.4	128
	6–10 years	19.2	109
	11–20 years	22.9	130
	>20 years	35.4	201
Surfing level	Novice/beginner	4.2	24
	Intermediate	20.9	119
	Advanced	65.5	373
	Expert/professional	9.5	54
How often do you go surf?	Everyday	4.4	25
	5-6 times per week	9.4	53
	3-4 times per week	17.6	100
	1-2 times per week	31.0	176
	1-3 times per month	22.8	130
	3 to 11 times per year	14.9	85
How long is a typical session	< 1 h	15.8	90
	2 h	66.7	380
	> 3 h	17.4	99
Who do you surf most often with?	Alone (no-one in the water)	2.1	12
	Alone (other people in the water)	43.1	245
	Friends	42.9	244
	Family	10.5	60
	Others	1.4	8
Distance from home	Within walking distance	10.4	59
	Within 10 min drive	25.0	142
	10–30 min drive	30.6	174
	30 min to an hour drive	20.6	117
	More than an hour drive	7.2	41
	I only surf on holidays/ vacation	6.3	36
Member of national surfing federation	Yes	19.4	110
	No	80.6	459
Have you ever taken formal surfing lessons?	Yes	53.6	305
	No	46.4	264
First aid skills[a]	Civil First aid general	49.2	280
	Ocean life saver	23.9	136
	Medical professional	10.9	62
	Others	9.2	52
Training is update	Yes	36.6	208
	No	25.5	145
	Don't know or no answers	37.8	215

[a] Several possible responses.

Table 2
Descriptive statistics for people rescued by surfers (N = 259).

Question	Response	%	N
Gender of person rescued[a]	Male	72.8	189
	Female	26.9	70
	Other	0.4	1
Age of person rescued[a]	Child (<12)	7.1	18
	Teen (12–19)	19.0	49
	Young adult (20–30)	36.9	96
	Adult (30–50)	26.1	68
	Older adult (50–65)	7.5	19
	Senior (65 +)	3.4	9
How was the person at time of rescue?[b]	Exhausted	42.2	109
	Panicked	38.8	100
	Unaware of the danger	17.9	46
	Embarrassed	17.2	45
	Calm	14	36
	Other	3	8
	Unconscious	1.9	5
How was the person after the rescue?[b]	Thankful	52.6	136
	Ok, could walk away	37.3	97
	Unaware of the danger they were in	18.7	48
	Required medical attention	12.3	32
	Other	9.3	24
	Not thankful	9	23
What was the person doing prior to needing rescue?[a]	Swimming, couldn't touch bottom	48.5	126
	Surfing	32.1	83
	Body boarding/boogie boarding	7.5	19
	Swimming, could touch the bottom	6.0	16
	Other	5.6	15
	Snorkelling	0.4	1

[a] One answer only.
[b] Several answer possible.

Table 3
Descriptive statistics of rescue circumstances (N = 259).

		%	N
What was the weather like?[a]	Sunny, fine day	64.4	167
	Overcast, warm	14.2	37
	Overcast, cold	9.7	25
	Raining	1.7	4
	Don't remember	10.0	26
Rip current related ?[a]	Yes	66.1	171
	No	31.1	81
	Don't remember	1.4	4
	Don't know	1.4	4
Was there lifeguards ?[a]	No lifeguards	59.1	153
	Yes, lifeguards	19.9	52
	Before/after patrol hours	15.3	40
	Don't remember	4.3	11
	Don't know	1.4	4
How the surfer became involved in the rescue?[a]	The surfer saw the person(s) in trouble and volunteered to help	84.8	220
	The person(s) ask for help	6.8	18
	A family member or friend of the person(s) in trouble requested surfer's help	4.4	11
	Other	4.1	11
	A lifeguard/lifesaver requested surfer's help	0.0	0

[a] One answer only. Total of responses equals 100%.

self-reported having previously conducted a rescue. This rate is remarkably close to the one obtained in the previously mentioned study by the French Surfing Federation, although the sample was different (Fédération Française de Surf, 2019). It is higher than the results obtained by Berg et al. (2021) across Europe (<5% French respondents), where 39% of surfers declared having performed a rescue. By saving lives, surfers provide a valuable public health service, albeit an informal one. This service also has a significant economic value by reducing the cost of providing medical care to victims in the case of non-fatal drownings and the loss of human life in the case of fatal drownings (Deloitte Access Economics 2020). Currently, the economic benefits associated with the development of recreational surfing are typically limited to individual use values or indirect economic impacts, i.e. the

Table 4
Binomial Logistic regression of conducting a rescue.

	OR	2.5%	97.5%	p	Sign
Intercept	0.145	0.045	0.447	0.000	***
Gender (Male/Female)	0.633	0.352	1.132	0.123	
Age group					
18–24 years (reference)					
25–35 years	1.249	0.710	2.201	0.439	
36–45 years	0.912	0.445	1.864	0.802	
46–55 years	1.073	0.449	2.572	0.873	
56 and older	0.826	0.247	2.847	0.758	
Surf experience					
Less than 5 years (reference)					
6–10 years	1.206	0.614	2.364	0.584	
11–20 years	1.429	0.702	2.917	0.324	
20 years or more	3.655	1.520	8.932	0.004	***
Advance or Pro level (No/Yes)	2.184	1.150	4.205	0.017	**
Having being injured (No/Yes)	3.576	1.925	6.845	0.000	***
Frequency of surfing session					
Less than once a month per year (reference)					
1 to 3 times per month	0.894	0.455	1.753	0.744	
1 to 2 times per week	1.459	0.767	2.783	0.249	
3 to 4 times per week	0.961	0.458	2.016	0.917	
More than 5 per week	3.423	1.373	9.009	0.009	***
Duration of surfing sessions					
Less than 2 h (reference)					
2 h	0.957	0.512	1.775	0.889	
3 h and more	1.436	0.676	3.062	0.345	
Member of the French National Surfing Association (No/Yes)	2.617	1.423	4.954	0.002	***
Receive formal surfing lessons (No/Yes)	0.636	0.394	1.026	0.063	*
Receive general first aids training (No/Yes)	0.732	0.481	1.111	0.1438	
Receive ocean lifeguard training (No/Yes)	0.997	0.601	1.660	0.992	

* ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

benefits surfers derived from their contact with nature (Nelsen 2017) or the profits made by the sports industry or local tourism companies (Murphy and Bernal 2008). In further research, the benefits of performing bystander rescues could be added to the economic value of recreational surfing (Lazarow et al., 2009). Key findings and their implications for beach safety management are now discussed.

4.1. Combining field experience and formal training

As in Berg et al. (2021), Attard et al. (2015) and De Oliveira et al. (2023), experienced and strongly skilled surfers reported a higher probability of having performed a rescue than other surfers. In contrast to Berg et al. (2021) and Attard et al. (2015) however, neither gender or having previous ocean lifeguard training had a significant influence on the probability of having performed a rescue. It should be noted that in the case of the Attard et al. (2015) study, Australia has a strong surf lifesaving movement and many surfers would likely have benefit from previous involvement in surf life saving clubs, which includes basic lifeguard training skills. In the absence of this type of surf lifesaving movement, it is likely that in France, empirical surfing experience prevails over formal training in the process of performing a rescue. This result is quite similar to what has been observed on a study of kite surfing in Denmark (Andkjaer and Arvidsen 2015), which has shown that some skills acquired in the natural environment could compensate for the lack of formal safety skills training. However, this is probably true up to a certain limit as several emergency actions (e.g. resuscitation) must be learned, and annually updated, according to formal protocols (Wyckoff et al., 2021). It is therefore necessary to develop first aid training for surfers in France and it is reassuring to see that most surfer respondents declared they are willing to attend specific safety training.

Surfers who had experienced an injury were more likely to have self-reported performing a rescue. In the literature, the influence of past injuries on attitudes or personal behaviors has already been demonstrated (Barnett and Breakwell 2001, Martha et al., 2009). To our knowledge, this is the first time it has been demonstrated to potentially have a positive influence on behavior towards other people as well. Although we could intuitively imagine that the time spent in the water increases the overall chances of finding oneself in the situation of having to rescue someone, we have shown that the number of times an individual goes surfing is a stronger predictor of performing a bystander rescue than the amount of time spent in the water. This result also helps to improve our knowledge of the overall contribution of exposure to risk (Koon et al., 2023). Compared to non-surfers, surfers are exposed to specific risks, however in our sample, many rescued surfers were more likely to receive medical attention. This is in line with other studies which have shown that the proportion of spinal and cervical injuries is higher among surfers (Castelle et al., 2018; Thom et al., 2022). This result suggests that rescue training should be differentiated according to whether it applies to surfing or to other water-based recreational activities.

4.2. Continue and expand communication from official surfing bodies

Though people mostly surf alone, or with peers, rather than as affiliates of formal organizations, we show that surfer association with official institutions has a positive role on the probability of carrying out a rescue, as well as increasing willingness to take safety-training. This supports the hypothesis that the program launched by the National French Surfing Federation appears to be targeting its intended audience and/or that people who received training via membership see value in it.

Those who self-reported having received formal surfing lessons were less likely to report having rescued someone. This result is consistent with the other results of the binomial regression model, as surfing lessons have developed recently and the most experienced surfers may not have had access to them. It is worth noting that the youngest surfers were more willing than others to take part in ocean lifesaving training. This result is promising, as several studies have shown that the benefits of outdoor skills are particularly important for teenagers and young

Table 5
Self-reported injury while surfing by severity of injury and demographic variables.

		No	Yes Minor injury	Yes Major injury	χ^2(p value)
Gender	Woman	15.9%	45.1%	39.0%	15.240 ($p < 0.01$)
	Man	27.5%	51.4%	21.1%	
Age	18–24 years	17.0%	60.8%	22.2%	26.387 ($p < 0.01$)
	25–35 years	19.3%	46.0%	34.7%	
	36-45 years	17.9%	41.0%	41.0%	
	46–55 years	16.5%	13.7%	24.6%	
	56 and older	24.1%	34.5%	41.4%	
TOTAL		18.1%	46.2%	35.7%	–

Table 6
Multinomial regression model for taking part in a basic lifesaving course for surfers.

		OR	2.5%	97.5%	p	
Interested in taking part in courses if it is free	Intercept	23.738	5.124	109.957	0.000	***
	Gender (Male/Female)	1.703	0.599	4.838	0.317	
	Age group					
	18–24 years (reference)					
	25–35 years	0.369	0.115	1.182	0.093	*
	36–45 years	0.162	0.047	0.553	0.003	***
	46–55 years	0.141	0.037	0.541	0.004	***
	56 and older	0.073	0.014	0.371	0.001	***
	Surf experience					
	Less than 5 years (reference)					
	6–10 years	0.472	0.155	1.436	0.186	
	11–20 years	1.485	0.403	5.461	0.551	
	20 years or more	1.165	0.302	4.487	0.824	
	Advance or Pro level (No/Yes)	0.792	0.292	2.142	0.647	
	Having being injured (No/Yes)	0.920	0.388	2.179	0.849	
	Having performed a rescue (No/Yes)	1.150	0.576	2.299	0.690	
	Member of the French National Surfing Association (No/Yes)	1.870	0.691	5.062	0.217	
	Receive formal surfing lessons (No/Yes)	1.345	0.654	2.766	0.418	
	Receive general first aids training (No/Yes)	1.407	0.760	2.602	0.276	
	Receive ocean lifeguard training (No/Yes)	0.296	0.149	0.590	0.000	***
Would be willing to pay for it	Intercept	8.794	1.716	45.053	0.009	***
	Gender (Male/Female)	2.257	0.751	6.780	0.146	
	Age group					
	18–24 years (reference)					
	25–35 years	0.266	0.077	0.913	0.035	**
	36–45 years	0.098	0.025	0.377	0.000	***
	46–55 years	0.151	0.035	0.653	0.011	**
	56 and older	0.093	0.015	0.557	0.009	***
	Surf experience					
	Less than 5 years (reference)					
	6–10 years	0.406	0.121	1.368	0.146	
	11–20 years	1.272	0.312	5.182	0.736	
	20 years or more	1.207	0.268	5.430	0.805	
	Advance or Pro level (No/Yes)	0.600	0.201	1.785	0.359	
	Having being injured (No/Yes)	0.869	0.333	2.267	0.775	
	Having performed a rescue (No/Yes)	1.162	0.533	2.529	0.704	
	Member of the French National Surfing Association (No/Yes)	3.158	1.104	9.029	0.031	**
	Receive formal surfing lessons (No/Yes)	1.852	0.821	4.177	0.137	
	Receive general first aids training (No/Yes)	1.328	0.666	2.646	0.419	
	Receive ocean lifeguard training (No/Yes)	0.556	0.259	1.195	0.132	

* ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

adults (Holland et al., 2018). Considering that more young people are taking surfing lessons, the latter could also be used to strengthen the role of surf schools in safety training and provide safety information for use when confronted with a rescue situation. Although the number of surf schools is constantly increasing, their role is still currently underestimated (Sotés et al., 2020).

Having performed a rescue does not increase the likelihood of willingness to undergo training, whether paid or free of charge. This result is somewhat ambiguous as it suggests that training can be provided early in a surfer's career, i.e. before they perform a rescue, but that conducting a rescue does not necessarily encourage surfers to improve their safety knowledge despite results of this study showing that their knowledge of rescue techniques is limited. In terms of dissemination policies, it would therefore be important to further stress the value of training, even for those who have already been involved in a rescue, as this study has shown that French surfers still favor their experience over formal knowledge.

4.3. Co-constructing a common beach safety culture

The high number of respondents to the French Global Surfer Survey suggests that the issue of safety and surfer rescues resonates with surfers and that they are willing to get involved in beach safety management. Indeed, many respondents declared they were aware of their responsibility with regards to water safety. A logical outcome would be to integrate surfers more formally into existing beach safety management strategies, albeit with consideration of two key questions. The first involves surfers' readiness and willingness to move from spontaneous action to action within an organization, which involves additional constraints (e.g. perform specific actions, measure parameters, call for help) that surfers might not be familiar with, or willing to adopt. This is referred to as the intention-behaviour gap (Fishbein and Ajzen 2009). Our study has shown that surfers can make an important contribution to the development of a public health database on drowning, which is an essential component in the definition of prevention strategies (Koon et al., 2021; Lawes et al., 2021). On a more general basis, this is consistent with other studies demonstrating the value of citizen-based science (Lauro et al., 2014; Reineman et al., 2017; Skriver Hansen et al., 2021).

The second question is whether organizations/individuals in charge of beach safety are willing to give surfers an acknowledged role in beach safety management. Surfers, and surfing culture, have traditionally not had a favorable reputation (Ponting et al., 2005), although recent sociological studies have shown that many surfers belong to educated and affluent classes (Martin and Assenov 2012; Reineman 2016; Nelsen 2017). The fact that no surfer in our sample has ever performed a rescue at the request of a lifeguard, whether or not in the supervised area, seemingly exemplifies this divide.

As with other outdoor activities, surfers appear to have their own safety culture (Martha et al., 2009; Buckley 2010; Andkjaer and Arvidsen 2015, Kamstra et al., 2021), which is undoubtedly based on the close knowledge they have acquired of ocean dynamics through time spent in

the water (Scarfe et al., 2009; Reineman et al., 2017). Following Mead et al. (2023), we think there is therefore a great deal of work to be done in building a new common beach safety culture that encourages to make the most of the local available resources and skills that all stakeholders professional or not, can provide to the common goal of enhance public safety.

4.4. Strengths and limitations

Globally, our survey completion rate is similar or even better than that observed in previous similar studies (Attard et al., 2015; Berg et al., 2021; Mead et al., 2023). Contrary to Attard et al. (2015) or Mead et al. (2023), our empirical strategy was able to reach a majority of non-Federation surfers across the country and a good proportion of surfers who have no lifesaving knowledge nor rescue experience. Indeed we believe in the importance of reaching surfers in their early years of surfing. Despite the care we have taken in this work, we are aware of several limitations. Firstly, our sample is still subject to selection bias. It is therefore likely that surfers who are particularly interested in the issue have responded to the survey. Secondly, many of the results are based on the surfers' self-reports and may suffer from social desirability bias. Therefore, it would be useful to extend this research with objective in-situ observational data. Finally, we are aware that the French cultural and institutional context inevitably influences the results. Similarly, we have not taken into account geographical and regional variations along the French coastline. This highlights the need for more studies of a similar nature to allow for geographical and cultural comparisons.

5. Conclusion

Our study shows that surfers make a major contribution to beach safety in France by acting as bystander rescuers. Personal experience and technical surfing ability prevail over formal first aid skills in the likelihood of a surfer conducting a rescue. Contact with nature seems to have allowed the development of a risk culture specific to surfers based on their own skills. There is a need for stronger cooperation between surfers and other professionals officially in charge of beach safety. Surfers have valuable experience to contribute and further knowledge exchange between surfers, lifesaving associations and the emergency health sector are needed in order to create a cohesive and broadly encompassing approach to beach safety management.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jeoffrey Dehez and David Carayon reports financial support was provided by Nouvelle-Aquitaine Regional Council. Jeoffrey Dehez and David Carayon reports financial support was provided by University of Bordeaux. Bruno Castelle reports financial support was provided by Nouvelle-Aquitaine Regional Council. Bruno Castelle reports financial support was provided by University of Bordeaux. Rob Brander, Amy E. Peden reports financial support was provided by Surfing New South Wales.

Data availability

Data will be made available on request.

Acknowledgement

Global Surfer Survey received the support of Surfing New South Wales, Australia. The French version of the surveys and this work received additional funding from Project SWYM (Surf zone hazards, recreational beach use and Water safetY Management in a changing climate) from Région Nouvelle-Aquitaine and the French government in the framework of the University of Bordeaux's Idex "Investments for the Future" program/RRI Tackling Global Change.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ocecoaman.2023.106973\.

References

Andkjaer, S., Arvidsen, J., 2015. Safety culture in water-based outdoor activities in Denmark. J. Outdoor Recreat. Educ. Leadersh. 7 (2), 140–157.
Attard, A., Brander, R., Shaw, W.S., 2015. Rescues conducted by surfers on Australian beaches. Accid. Anal. Prev. 82 (2015), 70–78.
Barnett, J., Breakwell, G.M., 2001. Risk perception and experience: hazard personality profiles and individual differences. Risk Anal. 21 (1).
Berg, I., Haveman, B., Markovic, O., et al., 2021. Characteristics of surfers as bystander rescuers in Europe. Am. J. Emerg. Med. 49 (2021), 209–2015.
Brander, R.W., Scott, T., 2016. Science of the rip current hazard. In: Tipton, M., Wooler, A., Reilly, T. (Eds.), The Science of Beach Lifeguarding: Principles and Pratictice. CRC Press, Boca Raton, pp. 67–86.
Brander, R.W., Warton, N., Franklin, R.C., et al., 2019. Characteristics of aquatic rescues undertaken by bystanders in Australia. PLoS One 14 (2), 10.137.1/journal.pone.0212349.
Brewster, B.C., Gould, R.E., Brander, R.W., 2019. Estimations of rip current rescues and drowning in the United States. Nat. Hazards Earth Syst. Sci. 19 (2019), 389–397.
Buckley, R., 2010. Adventure Tourism Management. Oxford University Press.
Castelle, B., Brander, R., Tellier, E., et al., 2018. Surf zone hazards and injuries on beaches in SW France. Nat. Hazards. https://doi.org/10.1007/s11069-0183354-4.
Castelle, B., McCarroll, R.-J., Brander, R.W., Scott, T., Dubarbier, B., 2015. Modelling the alongshore variability of optimum rip current escape strategies in a multiple rip-channelled beach. Nat. Hazards 81, 664–686.
Castelle, B., Scott, T., Brander, R., McCarroll, R.-J., 2016. Rip current types, circulation and hazards. Earth-Sci. Rev. 163, 1–21. https://doi.org/10.1016/j.earscirev.2016.09.008.
Castelle, B., Scott, T., Brander, R., McCarroll, J., Robinet, A., Tellier, E., de Korte, E., Sommonet, B., Salmi, L.-R., 2019. Environmental controls on surf zone injuries on high energy beaches. Nat. Hazard. Earth Syst. Sci. 19 (10), 2183–2205. https://doi.org/10.5194/nhess-19-2183-2019.
De Oliveira, J., Lorenzo-Martinez, M., Barcala-Furelos, R., Queiroga, C., Alonso-Calvette, A., 2023. Surfers as aquatic rescuers in Portugal and Spain: characteristics of rescues and resuscitation knowledge. Heliyon 9. May 2023.
Deloitte Access Economics, 2020. The Economic and Social Value of Surf Life Saving Australia. Sydney, Australia.
Fédération Française de Surf, 2019. Etude sur les surfeurs "sauveurs", Août 2019. Fédération Française de Surf, Hossegor, France.
Fishbein, M., Ajzen, I., 2009. Predicting and Changing Behavior - the Reasoned Action Approach. Psychology Press, Taylor and Francis.
Franklin, R.C., Pearn, J., 2014. Bystander Rescue" in Bierens JJLM, Drowning: Prevention, Rescue, Treatment. Springer, Berlin, Heidelberg, pp. 419–421.
Franklin, R.C., Pearn, J.H., 2011. Drowning for love: the aquatic victim-instead-of-rescuer syndrome: drowning fatalities involving those attempting to rescue a child. J. Paediatr. Child Health 47 (1–2), 44–47.
Franklin, R.C., Peden, A.E., Brander, R.W., Leggat, P.A., 2019. Who rescue who ? Understanding aquatic rescues in Australia using coronial data and a survey. Aust. N. Z. J. Publ. Health 43 (5), 477–486.
Gilchrist, J., Branche, C., 2016. Lifeguard Effectiveness" the Science of Beach Lifeguarding, p. 29.
Holland, W.H., Powell, R.B., Thomsen, J.M., Monz, C., 2018. A systematic review of the psychological, social, and educational outcomes associated with participation in wildland recreational activities. J. Outdoor Recreat. Educ. Leadersh. 10 (3), 197–225.
Hritz, H., Franzidis, A.F., 2018. Exploring the economic significance of the surf tourism market by experience level. J. Destin. Market. Manag. 7 (2018), 164–169.
Kamstra, P., Cook, B., Edensor, T., Kennedy, D., Kearnes, M., 2021. Relational risk and collective management: a pathway to transformational risk management. Risk Anal. 41 (10), 1782–1794.
Koon, W., Peden, A., Lawes, J., Brander, R., 2023. Mortality trends and the impact of exposure on Australian coastal drowning deaths, 2004–2021. J. Publ. Health 47 (2). https://doi.org/10.1016/j.anzjph.2023.100034. Australian and New Zealand.
Koon, W., Peden, A., Lawes, J.C., Brander, R.W., 2021. Coastal drowning: a scoping review of burden, risk factors, and prevention strategies. PLoS One 16 (2). https://doi.org/10.1371/journal.pone.0246034.
Lauro, F.M., Senstius, S.J., Cullen, J., et al., 2014. The common oceanographer: crowdsourcing the collection of oceanographic data. PLoS Biol. 12 (9) https://doi.org/10.1371/journal.pbio.1001947.
Lawes, J.C., Rijksen, E.J.T., Brander, R.W., Franklin, R.C., Daw, S., 2020. Dying to help: fatal bystander rescues in Australian coastal environments. PLoS One 15 (9), e0238317.
Lawes, J.C., Uebelhoer, L., Koon, W., et al., 2021. Understanding a population: a methodology for a population-based coastal safety survey. PLoS One 16 (8).
Lazarow, N., Miller, M., Blackwell, B., 2009. The value of recreational surfing to society. Tourism Mar. Environ. 5 (2–3), 145–158.

Le Corre, N., Saint-Pierre, A., Hughes, M., et al., 2021. Outdoor recreation in French Coastal and Marine Protected Areas. Exploring recreation experience preference as a way for building conservation support. J. Outdoor Rec. Tour. 33, 100332. March 2021.

Martha, C., Sanchez, X., Goma-i-Freixanet, M., 2009. Risk perception as a function of risk exposure amonsts rock climbers. Psychol. Sport Exerc. 10 (2009), 193–200.

Martin, S.A., Assenov, I., 2012. The genesis of a new body of sport tourism literature: a systematic review of surf tourism research (1997–2011). J. Sport Tourism 17 (4), 257–287.

Mead, J., Le Dé, L., Moylan, M., 2023. The unexplored role of surfers in drowning prevention: Aotearoa, New Zealand as case study. Environ. Hazards.

Murphy, M., Bernal, M., 2008. The Impact of Surfing on the Local Economy of Mundaka, Spain. Save the waves coalition, Davenport, USA.

Nelsen, C., 2017. Surfonomics: using economic valuation to protect surfing. In: Borne, G., Ponting, J. (Eds.), Sustainable Stoke. Transitions to Sustainability in the Surfing World. University of Plymouth Press, Plymouth, Devon, United Kingdom, pp. 104–109.

Pearn, J., Franklin, R., 2012. The impulse to rescue: a rescue altruism and the challenge of saving the rescuer. Int. J. Aquat. Res. Educ. 6, 325–355.

Ponting, J., McDonald, M., Wearing, S., 2005. De-constructing wonderland: surfing tourism in the Mentawai Islands, Indonesia. Soc. Leis. 28 (1), 141–162. https://doi.org/10.1080/07053436.2005.10707674.

R Core Team, 2019. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. https://www.R-project.org/.

Reineman, D.R., 2016. The utility of surfers' wave knowledge for coastal management. Mar. Pol. 67, 139–147.

Reineman, D.R., Thomas, L.N., Caldwell, M.R., 2017. Using local knowledge to protect sea level rise impacts on wave resources in California. Ocean Coast Manag. 138, 181–191.

Rulleau, B., Dehez, J., Point, P., 2012. Recreational value, site characteristics and user heterogeneity in contingent valuation. Tourism Manag. 33 (1), 195–204.

Scarfe, B.E., Healy, T.R., Rennie, H.G., 2009. Research-based surfing literature for coastal management and the science of surfing - a review. J. Coast Res. 25 (3), 539–597.

Skriver Hansen, A., Glette, V., Arce, J.F., 2021. Mapping recreational activities in coastal and marine areas - PPGIS findings from western Sweden. Ocean Coast Manag. 205 (105567).

Sotés, I., Basterretxea-Iribar, I., Sanchez-Beaskoetxea, J., de Las Mercedes Maruri, M., 2020. Environment Understanding, Signage Perception and Safety Education in Biscay Beachgoers under the View of Lifeguards, vol. 189. Ocean & Coastal Management. https://doi.org/10.1016/j.ocecoaman.2020.105149, 2020.

Thom, O., Roberts, K., Leggat, P.A., et al., 2022. Cervical spine injuries occurring at the beach: epidemiology, mechanism of injury and risk factors. BMC Publ. Health 22. https://doi.org/10.1186/s12889-022-13810-9.

Uebelhoer, L., Koon, W., Harley, M.D., Lawes, J., Brander, R.W., 2022. Characteristics and beach safety knowledge of beachgoers on unpatrolled surf beaches in Australia. Nat. Hazard. Earth Syst. Sci. Sci. 22, 909–926. https://doi.org/10.5194/nhess-22-909-2022.

Ung, A., Gautier, A., Chatignoux, E.N.B., 2022. Surveillance épidémiologique des noyades. Résultats de l'enquête NOYADES 2021, Le Point épidémio. Santé publique France, Saint-Maurice.

van Beeck, E.F., Branche, C.M., Szpilman, D., Modell, J.H., Bierens, J., 2005. A new definition of drowning: towards documentation and prevention of a global public health problem. Bull. World Health Organ. 83 (11), 835–836.

WHO, 2014. Global Report on Drowning. Preventing a Leading Killer. World Health Organization, Geneva, Switzerland.

Wilks, J., de Nardi, M., Wodarski, R., 2007. Close is not close enough: drowing and rescues outside flagged beach patrol areas in Australia. Tourism Mar. Environ. 4, 57–62.

Wyckoff, M.H., Singletary, E.M., Soar, J., et al., 2021. 2021 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Summary from the basic life support; advanced life support; neonatal life support; education, implementation, and teams; first aid task forces; and the COVID-19 working group. Resuscitation 129, 229–331 december 2021.

Zhu, Y.J.X., Li, F., Chen, J., 2015. Mortality among drowning rescuers in China, 2013: a review of 225 rescue incidents from the press. BMC Publ. Health 15 (1), 631.