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ORIGINAL PAPER

Camaraderie, common pool congestion, and the optimal size of surf gangs

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Abstract
This study integrates some of the seminal public choice research on clubs and recent research on prison gangs into an analysis of the formation of surf gangs. More specifically, this study presents a model examining how surf break congestion, localism effort, and surfing camaraderie work to determine the optimal size of a local surf gang. The benefits of surfing in groups fall under the heading of camaraderie, and their presence means that the optimal surf gang size is bounded away from one. The benefits of camaraderie in surfing will likely be exhausted at small numbers owing to crowding of the surf break.

Keywords Common-property resources · Club goods · Public choice

JEL Classification D71 · K11 · Q21 · Q26

1 Introduction

Recent surfing statistics published by WaveLoch.com indicate that there are 3.3 million surfers in the United States, and 35 million surfers worldwide.[1] These numbers are currently experiencing 12–15% growth per year, which is a positive development for the 162 countries, many of which represent developing economies, around the world that are surfing tourism destinations.[2] These numbers are also related

[1] Kvinta (2013) indicates that 64% (36%) of all U.S. surfers are male (female). These percentages translate to about 2.1 million (1.2 million) male surfers (female surfers) in the U.S.

[2] See waveloch.com.

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to staggering economic benefits, as $2.5 billion is added by surfers each year to the coastal economies of the U.S., a figure that is augmented by the $6.3 billion spent by Americans each year on surfboards, wetsuits, sunglasses and other surfing-related clothing and accessories (Kvinta 2013).[3] Moreover, as Scorse et al. (2015) point out, full capitalization of surf breaks occurs only when their impact on real estate valuations is included in the statistics. Their study addresses this issue by combining a hedonic price model with data from three distinct beach-adjacent neighborhoods in Santa Cruz, California. They find that, after controlling for proximity to the beach, ocean views and other property and neighborhood effects, proximity to surf breaks provides a significant boost to residential real estate values.[4]

An important aspect of surfing not encompassed by its macroeconomic impact described above is the common-pool nature of a surf break, where, at the point of congestion at the break, additional surfers contribute to negative congestion externalities. In this way, surfing is similar to commercial fishing. However, unlike vocations such as commercial fishing, surfing is an avocation for which positive network externalities are present. In this regard, surfing is much like other avocations or recreational activities wherein the utility of participants is enhanced by the participation of others. Thus, the utility or enjoyment received from surfing combines with the macroeconomics of surfing described above to make it an important activity in the U.S. and abroad.

The importance of surfing in the U.S. and elsewhere that is highlighted above provides a foundation for a recent series of economics studies of the governance of surf breaks by Kaffine (2009), Mixon (2014) and Mixon and Caudill (2018). This series provides a novel examination to the common property resource elements of surf breaks and how surf gangs are formed in an effort to prevent crowding of a local surf break by non-locals. This series also fits into the framework of two separate but related streams of the resource economics literature highlighting the positive association between private property rights and resource quality.[5] The general conclusion in this series is that "localism," or informal property rights protection that is backed by either threats of violence or actual violence, is exhibited to a greater degree (by surf gangs) at high-quality surf breaks than at low-quality surf spots. That is, where the benefits of localism are greater, surf gangs will form and expend greater resources producing localism effort.

As Kaffine (2009) indicates, the theoretical and empirical investigations in this recent series of economic studies concerns the second half of a two-stage model wherein user-enforced property rights are established, and not the first stage of that process wherein local surfers address the collective action problem associated with surf gang formation. This study addresses that void by examining the economics of surf gang formation, particularly how surf break congestion, localism effort, and surfing

[3] See also waveloch.com. Kvinta (2013) offers a good example of the importance of surf tourism in the U.S. by way of the Trestles surf break in San Diego County, California. This particular surf break is visited by 300,000 people annually, each of whom spends $80 per visit, for a total of $24 million each year. These and the foregoing statistics are perhaps unsurprising given that the median surfer earns $75,000 per year (waveloch.com).

[4] More specifically, results in Scorse et al. (2015) suggest that a residence that is adjacent to a surf break benefits from a $106,000 premium when compared to an equivalent residence a mile away.

[5] As this series of publications indicates, one stream is built on the foundational work of Gordon (1954), Scott (1955), Coase (1960), Hardin (1968), Ostrom (1990) and Cole (2002), and the other is represented in seminal studies by Demsetz (1967), Umbeck (1981) and Libecap (1989).

camaraderie work to determine the optimal size of a local surf gang. In doing so, this study integrates some of the seminal public choice research on clubs (e.g., Buchanan 1965; Cornes and Sandler 1996; Sandler 2013) and recent research on prison gangs (e.g., Skarbek 2014; Roth and Skarbek 2014) into an analysis of the formation of surf gangs. In providing an approach to the first stage of the two-stage model of the surf break commons, this study also provides a more complete picture of how informal governance may impact both the macroeconomic prospects and individual utility (enjoyment) associated with this important recreational endeavor.

2 Background and prior literature

In describing the common-pool elements associated with surfing, Rider (1998) employs a two-stage game theory model to explain how a surfer's etiquette evolved over time to address the coordination problem surfers face when competing for a choice wave at a given surf break.[6] One indication of this evolution is the development of boundary rules, which specify the requirements one must meet before "appropriation" of a resource can occur (Ostrom et al. 1994; Rider 1998). In the case of surfing, appropriation refers to taking ownership by way of riding the wave (Rider 1998). For example, one particular boundary rule in surfing is the *first-in-time, first-in-right* rule, which states that the "surfer closest to the curl, who stands up before any other surfer paddles toward that wave, or is nearest the peak on a peak wave has the right-of-way (Rider 1998, 58–59)."[7] Although this rule often ameliorates the coordination problem, it does not solve it (Rider 1998, 58–59). Another rule aimed at addressing the coordination problem is a "locals only" rule, whereby only local surfers are allowed access to a given surf break. This rule often arises as a response to an influx of non-local surfers, also known as "highway surfers" (Rider 1998), who are in many cases less experienced.

The "locals only" response refers to the congestion at a given surf break, a "tragedy of the commons" situation, resulting from the influx of non-local surfers. It is this idea that motivated Kaffine's (2009) seminal study on surfing commons quality and the informal property rights established by surf gangs all along California's southern coastlines. Through his formal economic model, Kaffine (2009) discusses the observationally equivalent conclusions of two separate theoretical approaches to the subject. The first is developed in the series of foundational studies by Gordon (1954), Scott (1955), Coase (1960), Hardin (1968), Ostrom (1990) and Cole (2002), and it asserts that common-property resources often suffer from overexploitation due to a lack of well-defined property rights. As Kaffine (2009) indicates, this overexploitation is avoided through the development of private property rights, which also provides rent preservation and an improvement in the quality of the common-pool resource.

The second theoretical approach is articulated through work by Demsetz (1967), Umbeck (1981) and Libecap (1989), and it asserts that property rights are endogenous

[6] According to surfline.com's *Surfology* glossary (https://www.surfline.com/surfology/surfology_glossary_index.cfm), a "surf break" is a line where waves begin to break, which, *ceteris paribus*, generally occurs when they reach water depths equaling approximately 1.3 times the wave face height. A wave's face is the steepening shoreward front of a wave, where most riding takes place (*Surfology*).

[7] A "curl" is an "older term used to describe the concave face of the wave just before breaking (*Surfology*)."

to resource quality, as they are created by resource users when their benefits, which grow larger with higher resource quality, exceed the costs of their creation, as in the historical case of mineral rights creation across the western U.S. (Kaffine 2009). In this approach, property rights tend to develop around high-quality resources. Hence, whether higher resource quality is a function of well-defined, private property rights or vice versa, the observational equivalence in these two separate approaches is that private property rights are generally associated with high-quality resources. In the case of common-pool surf breaks, informal property rights are established through violence and/or threats of violence by surf gangs made up of local surfers. Using data from 86 surf breaks along the southern coast of California, along with measures of surf break (i.e., resource) quality and localism, Kaffine (2009) finds, in support of his formal model, that local surfers' attempts to seize the common surf break increase in ferocity by seven to 17% as the quality of the surf break increases by 10%.

Kaffine's (2009) formal model, and empirical evidence, informed recent empirical studies by Mixon (2014) and Mixon and Caudill (2018). The former study extends Kaffine's (2009) empirical work to include modified measures of surf break quality and the degree of localism in order to examine property rights enforcement activities by surf gangs at 143 separate surf breaks along all of California's coastlines. Mixon (2014) finds that a marginal increase in surf break quality leads to an increase of about 25 percentage points in the probability of observing fierce protection (by surf gangs) of surf breaks. The latter study focuses on the relationship between localism and surf break quality, across 31 well-known big-wave surf breaks around the globe, using an objective metric of surf break quality. Mixon and Caudill (2018) find that a marginal increase in big-wave surf break quality leads to an increase of more than 30 percentage points in the probability of observing fierce protection (by surf gangs) of big-wave surf breaks. As such, they conclude that big-wave surfing represents a market or environment that is distinct from traditional-wave surfing.

Before examining the economic determinants of the optimal size of a surf gang, a brief review of Kaffine's (2009) second stage model of the surfing commons is provided in the next section of the study. Here, particular attention is paid to user-enforced property rights in surfing and the closing of the surfing commons by local surf gangs.

3 Locals, non-locals and the commons: the Kaffine model

Kaffine (2009) provides the second half of a two-stage model regarding the collective action problem of surf gang formation, or stage one, and the determination of user-enforced informal property rights protection, or stage two. As a prelude to presentation of some of the elements in the first stage, which is the main thrust of this study, a brief review of the second stage is provided in the two sub-sections that follow.

3.1 User-enforced property rights: the Kaffine model

Kaffine (2009, 731) considers a fixed number of local surfers, $\bar{n}_L$, who maximize their return from a resource of exogenous quality by collectively determining a level of exclusionary effort, referred to as localism, to apply to non-local surfers, n_{NL}, such that,

$$\max_{y} U_{\mathrm{L}}(q, n_{\mathrm{NL}}) - c(y), \tag{1}$$

where U_{L} captures the utility that local surfers receive from a surf break of exogenous quality, q, with congestion from an expected number of nonlocals, n_{NL}.[8] Here, it is costly for local surfers to exclude non-local surfers, as represented by $c(y)$, which is increasing ($c'(y)>0$ and $c''(y)>0$) in the level localism, y (Kaffine 2009, 731). Next, Kaffine (2009, 731) also assumes that the benefits derived from a given surf break increase with surf break quality ($\partial U_{\mathrm{L}}/\partial q > 0$) and decrease with congestion ($\partial U_{\mathrm{L}}/\partial n_{\mathrm{NL}} < 0$), while the marginal benefit from resource quality is decreasing with congestion ($\partial^2 U_{\mathrm{L}}/\partial q \partial n_{\mathrm{NL}} < 0$). Lastly, the utility function in (1) above assumes that the number of local surfers, $\bar{n}_L$, has no influence on their own utility, which means that (1) above represents "a second-stage decision after local [surfers] have worked out the first-stage collective action problem (Kaffine 2009, 731–732)."

Unlike members of the local surf gang, non-local surfers are large in number and will access a given surf break if the value to them of surfing there meets or exceeds the next-best alternative (Kaffine 2009, 732). Hence, a given surf break faces infinite congestion pressure from the surrounding geography, and all non-local surfers receive utility, $\bar{V}$, under open access to the surf break (Kaffine 2009, 732). Hence,

$$U_{\mathrm{NL}}(q, n_{\mathrm{NL}}) - p(y) = \bar{V}, \tag{2}$$

where U_{NL} captures the benefits non-local surfers receive from a surf break of quality, q, with congestion from other non-local surfers, n_{NL}, and $p(y)$ is the increasing punishment of localism, y, at the surf break. As Kaffine (2009, 732) adds, the assumptions regarding U_{NL} mirror those regarding U_{L} (i.e., $\partial U_{\mathrm{NL}}/\partial q > 0$, $\partial U_{\mathrm{NL}}/\partial n_{\mathrm{NL}} < 0$, and $\partial^2 U_{\mathrm{NL}}/\partial q \partial n_{\mathrm{NL}} < 0$).

Finally, from (2) the expected number of non-local surfers can be expressed as a function of surf break quality, the degree localism exhibited by the local surf gang, and reservation utility,

$$n_{\mathrm{NL}} = n(q, y, \bar{V}), \tag{3}$$

such that n_{NL} is increasing in q, decreasing in y, and decreasing in $\bar{V}$ (Kaffine 2009, 732).[9]

[8] Kaffine (2009, 731) adds that treating surf break quality as exogenous "isolates the incentives locals have to close the commons."

[9] As Kaffine (2009, 732) points out, these conclusions are intuitive given that a higher quality surf break will draw the interest of a larger number of surfers, fiercer property rights protection will deter more surfers from accessing the surf break, and fewer surfers will be interested in surfing a given break if better returns can be had elsewhere.

3.2 Closing the commons: the Kaffine model

When local surfers decide y, they will choose a level of localism with the knowledge that they can exclude some of the non-local surfers by making it more costly for them to enjoy the surf break (Kaffine 2009, 732). As such, substitution of (3) into (1) provides,

$$\max_{y} U_{\mathrm{L}}[q, n(q, y, \bar{V})] - c(y), \tag{4}$$

which is solved with an optimal level of localism, $y^* \geq 0$ (Kaffine 2009, 732). How is surf break quality related to the benefits local surfers derive from the break? To develop an answer, Kaffine establishes the value function for local surfers as,

$$V = \max_{y} U_{\mathrm{L}}[q, n(q, y, \bar{V})] - c(y), \tag{5}$$

where a change in the local surfers' value function resulting from a change in surf break quality, $\partial V/\partial q$, is given by,

$$\frac{\partial V}{\partial q} = \frac{\partial U_L}{\partial q} - \frac{(\partial U_L/\partial n)}{(\partial U_{NL}/\partial n)} \frac{\partial U_{NL}}{\partial q}, \tag{6}$$

which may be positive, negative, or equal to zero (Kaffine 2009, 733).[10]

Through three analytical examples, Kaffine (2009) describes how the tension between direct benefits associated with surf break quality and indirect costs from surf break congestion is resolved. In one of these, local surfers derive convex benefits from increasing surf break quality and non-local surfers derive constant benefits from increasing surf break quality. In this case, an increase in surf break quality leads to additional entry by non-local surfers, thus creating an incentive for the surf gang to increase localism in order to avoid the large negative utility from increased surf break congestion, so that $\partial y^*/\partial q > 0$ (Kaffine 2009, 734).[11]

4 Camaraderie, congestion and the optimal size of surf gangs

The idea from (1) above, that the number of local surfers has no influence on their own utility, leads Kaffine (2009, 731–732) to describe his model of user-enforced property rights as a second-stage decision that occurs after local surfers have worked out the first-stage collective action problem. The main thrust of this study is to model an

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[10] As Kaffine (2009, 733) indicates, the first term in (6) captures the direct benefits that local surfers receive from the surf break, while the second term captures the indirect congestion costs due to an increase in non-local surfers.

[11] As Kaffine (2009, 734) adds, here surf break congestion disutility affects local surfers more than it does non-local surfers, such that $\partial U_{\mathrm{L}}/\partial n < \partial U_{\mathrm{NL}}/\partial n$ and $\partial U_L^2/\partial q \partial n < \partial U_{NL}^2/\partial q \partial n$, and (1) takes the form, $\max_{y}(B_L q^2/n) - cy^2$, while (2) takes the form, $(B_{\mathrm{NL}} q/n) - py = \bar{V}$. Lastly, rearranging for n and inserting into the local surfers' optimization problem and solving for y^* yields, $y^* = q(B_{\mathrm{L}} p/2B_{\mathrm{NL}} c)$ (Kaffine 2009, 734).

important element of the first-stage collective action problem faced by local surfers, which is determining the optimal size of a surf gang. An obvious consideration in this determination is that at the point of surf break congestion, any expansion in the size of the surf gang contributes to negative congestion externalities. Thus, surf break congestion not only results from attempts by non-local surfers to access a surf break, it can also occur when the number of local surfers, or surf gang members, is exceedingly large. The limiting cases where no surf gang forms, and an invasion of non-locals who do not face any localism occurs, and that where all surfers, locals and non-locals, at a given break become surf gang members, provide an example of this situation. The surf breaks along the shores of Malibu, California, where there are "five or six guys on every wave" (Aron 2016), are typical of this scenario (see also Harper 2015; Ferry 2016).

On the other hand, consider the hypothetical case of a Goliath-like surfer who is capable by his or her size to exclude all others from use of a surf break. While such a situation may be optimal in the case of a commercial fishery, it is not likely to be the case where positive network externalities are present. Golfing is a good example of an activity where, at the point of congestion on the course, additional players contribute to the type of negative congestion externalities discussed above. Golfing is also a social activity that provides added enjoyment when a player is accompanied in the activity by other players. In fact, while much of the benefit derived by golfers from the activity is derived through participation in it, there are additional benefits derived from the seemingly endless stories of past golfing excursions that are told and retold within groups of golfers in post-round and other gatherings. Surfing shares this property, as surfers derive significant enjoyment from shared experiences that are told and retold in various other social settings over time.

A useful example of the importance of camaraderie involves Jeff Clark and the famed big-wave surf break in California known as Mavericks, which is located just north of Half Moon Bay, which is 25 miles south of San Francisco (Clark 2013). In 1975, Clark "discovered" (i.e., sighted) the extraordinary break from above, on his school's campus grounds.[12] He surfed alone there for 10 years before getting bored and heading 50 miles south to Santa Cruz to enjoy its high-quality surf breaks (Clark 2013; Mixon 2014). It was on one of these trips to Santa Cruz that Clark decided to invite other big-wave surfers (and friends), beginning with Dave Schmidt and Tom Powers, to join him on a future excursion to Mavericks (Peralta and George 2004; surfline.com; innatmavericks.com).[13] Shortly after that trio surfed together at Mavericks for the first time, the group grew to 12 surfers, although the composition of those outside of the core of Clark, Schmidt and Powers were, due to failure to handle the size of the waves, somewhat transient (Clark 2015).

The benefits of surfing in groups described above fall under the heading of camaraderie, and their presence means that the optimal surf gang size, n_L*, is bounded,

[12] Other sources (http://www.innatmavericks.com/blog/mavericks-half-moon-bay/) classify Clark as a re-discoverer of Mavericks, and instead attribute its original discovery to Half Moon Bay surfers Alex Matienzo, Jim Thompson and Dick Knottmeyer, who first surfed there in 1967.

[13] Kaffine (2009, 729) points out that many local surfers feel that they own a surf break after surfing it for years, thus replicating patterns of behavior that have been observed in common-pool lobster fisheries (Acheson 1988). In a brief footnote, Mixon (2014, 381) cites the Clark/Mavericks case as an extreme example of "local surfer ownership".

from below, away from one. Still, the benefits of camaraderie in surfing will likely be exhausted at small numbers owing to crowding, which is evident when surfers crowd the choice spot where the swells are the highest, sometimes even colliding with one another.[14] The exact value of n_L* is ultimately a function of economic and resource factors, such as the size of the surf break. It may also be a function of the given surfing "market," as Mixon and Caudill (2018) argue that big-wave surfing is a distinct surfing market (from traditional surfing) given that it involves distinct technologies, more specialized techniques and greater inherent danger. For example, surfing large waves may involve tow-in approaches that employ jet skis and specialized surf boards (Mixon and Caudill 2018). As in Kaffine (2009) and Mixon (2014), and unlike Mixon and Caudill (2018), this study focuses on high-quality, traditional market surf breaks.

The current approach to modeling optimal surf gang size is built on recent research by Skarbek (2010, 2011, 2012 and 2014) and Roth and Skarbek (2014) on how prison gangs provide governance, or social order, that works to benefit prisoners. Following Roth and Skarbek (2014, 232), the average cost of operation per person to a surf gang is modeled as a function of its size, where size is defined as the absolute number of surf gang members (i.e., local surfers).[15] As the number of surf gang members, n_L, increases in size, the fixed costs of localism effort, y, aimed at non-local surfers, n_{NL}, fall on a per-member basis. The cost function, $C^y(n_L)$, in Fig. 1 illustrates this decreasing cost of localism effort. As with the case of prison gangs (Roth and Skarbek 2014), there are also other costs associated with the number of surf gang members, n_L. These costs relate surf gang size to two additional elements—camaraderie and congestion of the common pool. Borrowing from elements of club goods theory (Buchanan 1965; Cornes and Sandler 1996; Sandler 2013), the utility of the ith member of the surf gang can be expressed as,

$$U^i = U^i(z^i, \ldots, n_L), \tag{7}$$

where z^i is a private numéraire good and, as in Kaffine (2009), n_L is the number of local surfers at a given surf break. Following Sandler (2013, 268), $\partial U^i/\partial n_L < 0$ for $n_L > \bar{n}_L$. Based on Buchanan's (1965) approach, local surfers, n_L, enjoy camaraderie up to point $\bar{n}_L$, beyond which negative congestion externalities dominate (Sandler 2013, 268). Thus, $\partial U^i/\partial n_L > 0$ for $n_L \leq \bar{n}_L$. The camaraderie and subsequent congestion described here are illustrated by the cost function, $C^r(n_L)$, in Fig. 1. Up to point $\bar{n}_L$, this function reflects the negative "psychic costs" associated with camaraderie enjoyed by local surfers from surfing the break. Beyond point $\bar{n}_L$, congestion, r, dominates, leading to positive and increasing costs over n_L. Lastly, the summation of $C^y(n_L)$ and $C^r(n_L)$ yields the aggregate surf gang cost function, $C^A(n_L)$, shown in Fig. 1. This curve is minimized at n_L*, which represents the optimal number of local surfers, or the optimal size of a given surf gang, utilizing a given surf break.

[14] This assertion is supported by the relatively small group that eventually joined Clark at Mavericks.

[15] As in the Roth and Skarbek (2014) model of prison gang size, a surf gang may be developed on a hierarchical basis, meaning that there may be "degrees of membership" (see also Leeson and Skarbek 2010).

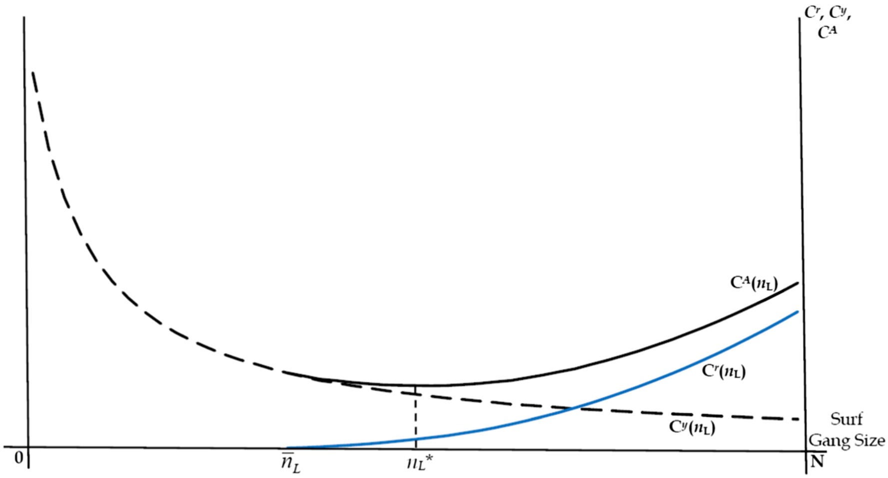

Fig. 1 Surf gang costs as a function of surf gang size

5 Empirical exploration and implications of the model

Table 1 includes information of eight of the most notorious surf gangs in the United States and Australia. It begins with the Bird Rock Bandits, which is a surf gang that protects the "storied break" at Windansea Beach in La Jolla, California (Aguirre 2008). The notoriety of the Bird Rock Bandits was boosted about 10 years ago, when five of its members, all in their 20s, were charged in a beating death (Aguirre 2008). The second gang in the list is the Bra Boys, which was established in the 1990s by four brothers—Sunny, Jai, Koby and Dakota Abberton—in order to protect a surf break at Cape Solander near Sydney, Australia.[16] Since its formation, the Bra Boys, who took the name "Bra" from Maroubra, which is the tough beach suburb they call home, have become known for their violent clashes with citizens and police.[17] This gang has more than 200 members, 160 of which engaged a brawl with police offers in 2002, injuring 30 of the officers.[18]

Da Hui, also known as the "Black Shorts" for their surfing attire, was founded in 1976 by locals of Oahu's famous North Shore surf breaks as a contrarian response to the closing of surf breaks there by surfing contest sponsors.[19] The gang, which has more than 400 members, responded by threaten[ing] and thrash[ing]… South African and Aussie [contest] surfers."[20] Next, although less is known about their ages and sizes, the well-known surf breaks at Santa Cruz, California, are contested by rival surf gangs, East Side and West Side. Much more is known about the Lunada Bay Boys, which is a surf gang from the affluent Los Angeles, California, community of Palos

[16] See *Surfer Today* (https://www.surfertoday.com/surfing/9554-the-most-feared-surf-gangs-in-the-world).

[17] See *Surfer Today* and IndoSurfLife.com.

[18] See IndoSurfLife.com.

[19] See IndoSurfLife.com.

[20] See IndoSurfLife.com.

Table 1 Descriptive statistics for eight notorious surf gangs

Surf gang	Location	Founded	Size	Nickname
Bird Rock Bandits	La Jolla, California	–	–	
Bra Boys	Sydney, Australia	1990s	>200	
Da Hui	Oahu's North Shore, Hawaii	1976	>400	Black Shorts
East Side	Santa Cruz, California	–	–	East Siders
Lunada Bay Boys	Palos Verdes Estates, California	1960s	≈40	Bay Boys
Silver Strand Locals	Oxnard, California	1980s	–	Silver Strand
West Side	Santa Cruz, California	–	–	West Siders
Wolfpak	Oahu's North Shore, Hawaii	2001	–	

Sources Aguirre (2008), Aron (2016), IndoSurfLife.com; Harper (2015), Medina (2017), Mondy (2016)

Verdes Estates that guards the high-quality surf break at Lunada Bay (Douglas 2017). The Bay Boys, which formed in the 1960s, is comprised of about 40 members, many of whom are relatively wealthy men in their 40s and 50s (O'Haver 2016; Douglas 2017). Since its formation, this gang has earned a reputation for viciousness, including a 1995 assault alleged to have been committed by one of its members that led to a civil injunction and financial settlement of $15,000 (Douglas 2017).[21]

Among the final two gangs in Table 1 is the Silver Strand Locals, which was formed in the 1980s and protects a "mile of high-quality beach breaks at Oxnard[, California]…via talented surfing, outright hostility and physical abuse (Mondy 2016)." As in the case of the other surf gangs listed in Table 1, intimidation by the Silver Strand Locals begins in the parking lots bordering the break, where they routinely slash car tires and damage the exteriors of vehicles using keys (Mondy 2016). Lastly, Wolfpak was formed in 2001 by Kala Alexander, who has served time in prison for assault, and Kai Garcia in order to protect an 11 km stretch of some of the world's best and biggest waves, [including] the Banzai Pipeline," along the northern shores of Oahu in Hawaii.[22] Wolfpak's named was chosen to reflect their brand of localism, which emphasizes teamwork (i.e., a pack mentality).[23]

Based on those gangs included in Table 1 for which data exist, the average age of the surf gangs in the table is 34 years.[24] Additionally, successful surf gangs are typically

[21] The victim in this case is a teacher who attempted to surf the Lunada Bay break but suffered a broken pelvis, allegedly at the hands of the Bay Boys (Harper 2015).

[22] See IndoSurfLife.com.

[23] See *Surfer Today*. For an ethnographic approach to surf gang behavior, see Usher and Gómez (2016). These authors examine the surf localism among local Costa Rican and foreign resident surfers in Pavones, Costa Rica, a well-known surf break considered the second longest left-breaking wave in the world. Through interviews they find that Costa Rican surfers feel a greater sense of ownership of the surf break, but were less likely to start verbal or physical conflicts with other surfers than resident foreigners, who indicated feeling a right to the break, more so than ownership.

[24] Data on surf gangs' ages, sizes, and activities are, perhaps unsurprisingly, relatively scant.

large, although their sizes exhibit wide variation. The average size of the gangs listed in Table 1 is about 214 members, with a standard deviation of 181 members. Recent public choice research suggests that the power of Mafias, as measured by their ability to access the political system, is inversely related to the level of violence they perpetrate (e.g., see Moro et al. 2016). Given that all of the gangs listed in Table 1 employ, or have employed, substantial violence in their protection of the various surf breaks, reaching a similar conclusion about surf gang power, as measured by surf gang size, would be tenuous at best.[25]

There are, on the other hand, some interesting conclusions that can be reached about the production of localism and the cost function, $C^y(n_L)$, in Fig. 1 that illustrates the decreasing costs of localism effort. In this regard, it is useful to point out that members of the Bra Boys and Da Hui come from relatively low income, if not impoverished, backgrounds. As Harper (2015) indicates, members of the Lunada Bay Boys "come from old money" and live in "posh" neighborhoods. As adults, the Bay Boys work as doctors, real estate brokers, and airline pilots (Douglas 2017). As such, and unlike the Bra Boys and Wolfpak, this gang has access to the portfolio capital necessary to deal with civil injunctions for acts of violence such as that discussed above. The Bay Boys' portfolio capital is also useful in supporting investments in physical capital that increase the productivity of the localism efforts of its members.

As in the case of the other surf gangs, the Bay Boys' intimidation and violence often begins in adjacent parking lots and includes the slashing of tires and keying of automobiles. However, these first-wave Bay Boys also employ walkie-talkies and other communications devices to warn other members who are located near the shoreline of an impending invasion of non-locals. It is there, at the shoreline, that the Bay Boys employed, until 2016, a medieval-style stone "fort," constructed at the base of the cliff overlooking the surf break (Douglas 2017). Such a structure, shown in Fig. 2, provided the Bay Boys with a platform for hurling rocks and other dangerous implements at those non-locals who advanced beyond the parking lot assaults. In this case, by increasing the productivity of the gang members' localism efforts, the physical capital investments made by the Bay Boys in equipment (e.g., walkie-talkies) and a physical plant (i.e., the "fort") lowered the cost of localism, $C^y(n_L)$, depicted above in Fig. 1.

The decrease in the cost of localism is shown through the new localism cost curve, $C^y(n_L)'$, depicted in Fig. 3, which lies below that of its Fig. 1 counterpart (i.e., $C^y(n_L)' < C^y(n_L)$). Moreover, the decrease in aggregate surf gang costs resulting from lower localism costs is shown through the new aggregate cost curve, $C^A(n_L)'$, depicted in Fig. 3, which lies below that of its Fig. 1 counterpart (i.e., $C^A(n_L)' < C^A(n_L)$). Lastly, as shown in Fig. 3, the investment in physical capital reduces the optimal surf gang size, in this case to $n_L{}^{*}{}'$, relative to that of $n_L{}^{*}$ in Fig. 1 (i.e., $n_L{}^{*} > n_L{}^{*}{}'$). This result is consistent with the finding that the Lunada Bay Boys gang consists of fewer members than other, relatively poorer surf gangs, such as the Bra Boys or Wolfpak, which do not employ similar productivity-enhancing physical capital. It also suggests that the method by which surf gangs establish informal property rights over a given surf break, which represents their solution to the second-stage problem discussed in Kaffine

[25] Given the small sample size, there is, admittedly, noise present in any statistical inference that is drawn in this portion of the study.

Fig. 2 Lunada bay boys' fort. Courtesy of *Los Angeles Times*

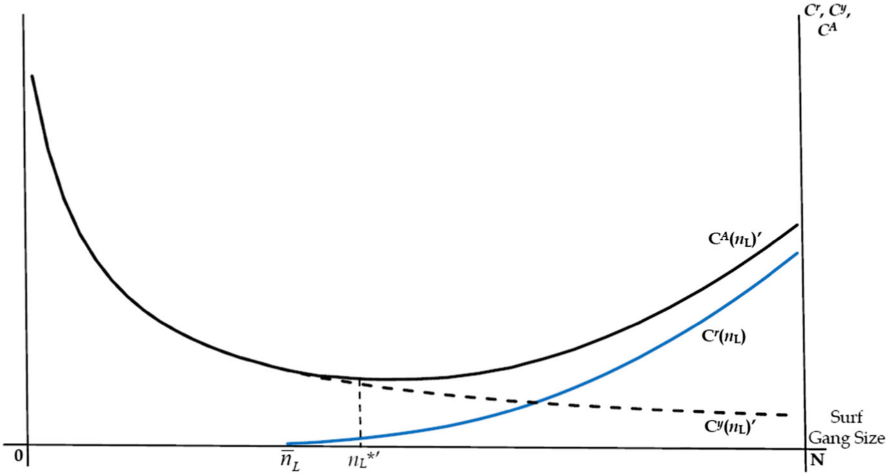

Fig. 3 Physical capital investment, localism costs, and optimal surf gang size

(2009), is shaped by aspects of how the collective action problem gives rise to surf gang size in the first stage.

Another aspect of the model worthy of discussion is the role of law enforcement effort in curbing surf gang localism at high-quality beach breaks. The law enforcement effort of local police officials works to reduce the ability of a surf gang to establish informal property rights over a surf break. Those well-known surf gangs listed in Table 1 often clash with law enforcement officials, as indicated by the aforementioned brawl between Australian law enforcement officials and 160 members of the Bra Boys surf gang. The criminal past of Wolfpak's Alexander also alludes to intersections

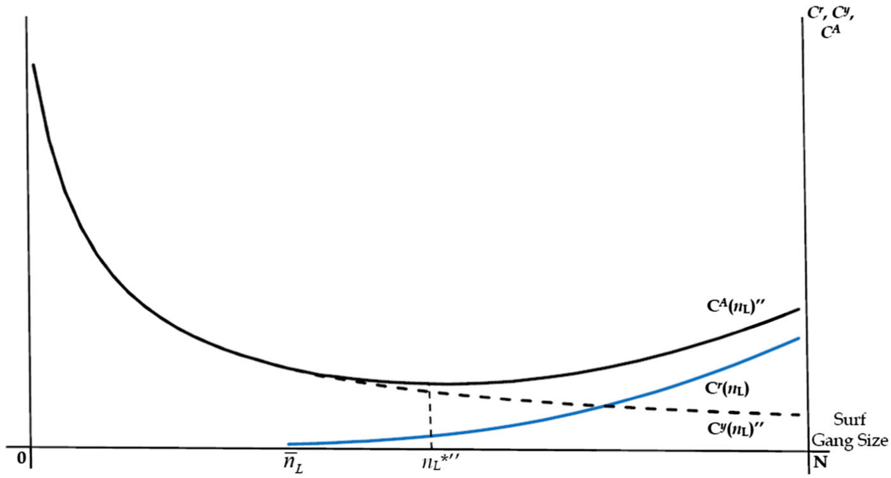

Fig. 4 Law enforcement effort, localism costs, and optimal surf gang size

between that surf gang and Hawaiian law enforcement officials. When the anti-localism efforts of law enforcement officials is increased, the cost of localism effort on the part of a surf gang increases.

The increase in the cost of localism resulting from slightly greater law enforcement effort is shown through the new localism cost curve, $C^y(n_L)$", depicted in Fig. 4, which lies above that of its Fig. 1 counterpart (i.e., $C^y(n_L)" > C^y(n_L)$). Moreover, the increase in aggregate surf gang costs resulting from higher localism costs is shown through the new aggregate cost curve, $C^A(n_L)$", depicted in Fig. 4, which lies above that of its Fig. 1 counterpart (i.e., $C^A(n_L)" > C^A(n_L)$). Lastly, as shown in Fig. 4, a slight increase in law enforcement effort increases the optimal surf gang size, in this case to n_L*", relative to that of n_L* in Fig. 1 (i.e., $n_L*" > n_L*$). Thus, larger surf gangs are expected where a marginal increase in law enforcement is observed.

Although the prior analysis indicating that larger surf gangs exist where greater law enforcement effort prevails is consistent with the Bra Boys and Wolfpak surf gangs, which number from more than 200 to more than 400 members, it is perhaps inconsistent with the relatively small size of the Lunada Bay Boys surf gang. Once again, however, the Bay Boys' financial portfolio perhaps provided them, at least for a time, with an alternative approach to law enforcement. For example, local news media, including the *Los Angeles Times*, have reported that city officials have historically dismissed allegations of intimidation and violence aimed at the Bay Boys (O'Haver 2016). In fact, the local police chief once described such allegations as being *un*newsworthy, and in some cases as merely "urban legend" (O'Haver 2016). Residents have in the past countered by informing the press that the Bay Boys "have been assaulting outsiders with the tacit approval of the police for decades (Harper 2015)." A federal case, initiated by a local resident, alleging local government inaction was filed in 2016. That case was dismissed in 2018 by the U.S. District Court (Pierson 2018).

These conflicting assessments are, when combined with reports of violence committed by the Bay Boys such those discussed above, reflective of a type of "capture" of

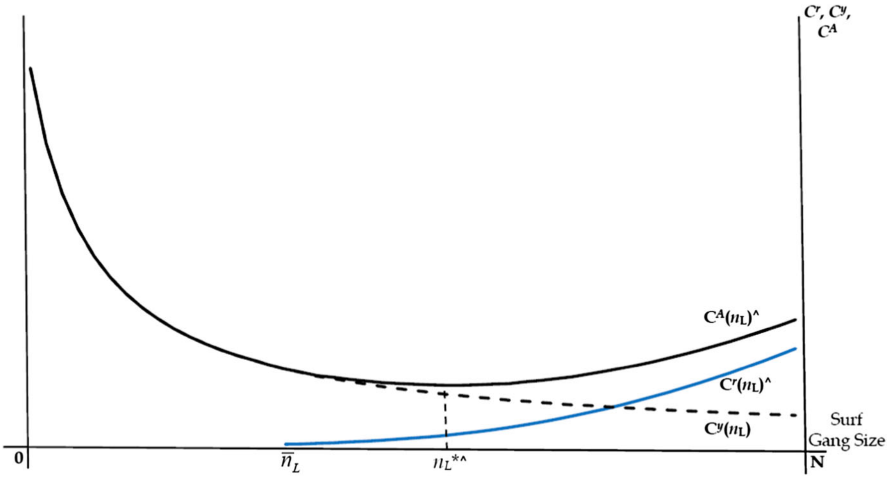

Fig. 5 Surf gang territory, congestion costs, and optimal surf gang size

local law enforcement by the relatively wealthy Bay Boys resembling that described in the case of traditional economic regulation in seminal studies by Stigler (1971), Peltzman (1976) and Laffont and Tirole (1991). In the case of the Bay Boys, gaining influence over local law enforcement officials who are either elected (e.g., county sheriff) or appointed (i.e., police chief) by an elected official (i.e., mayor) would have likely occurred through the type of rent seeking activity described in Tullock (1967, 1989) and Krueger (1974), and measured by Mixon et al. (1994), Laband and McClintock (2001) and Sobel and Garrett (2002). Even with the advantage of its portfolio capital, the Bay Boys lost the battle over the existence of its 30 year old "fort" in 2016, when it was demolished by city officials in response to a mandate from the California Coastal Commission (Douglas 2017).[26]

Lastly, there is an unexplored relationship between the size of a surf gang's territory and the cost function, $C^r(n_L)$, in Fig. 1 that illustrates the increasing congestion cost of surf gang membership. As indicated in prior discussion, Oahu's Wolfpak surf gang controls 11 km of high-quality surf breaks, including Hawaii's famed Banzai Pipeline. If one supposes that Wolpfak could add an adjacent 0.5 km of surf break to its existing, informal property rights portfolio, then the North Shore-based surf gang would face lower congestion costs of localism. The decrease in the congestion costs resulting from acquisition of adjacent surf breaks is shown through the new congestion cost curve, $C^r(n_L)\hat{}$, depicted in Fig. 5, which lies below that of its Fig. 1 counterpart (i.e., $C^r(n_L)\hat{} < C^r(n_L)$). Moreover, the decrease in aggregate surf gang costs resulting from lower congestion costs is shown through the new aggregate cost curve, $C^A(n_L)\hat{}$, depicted in Fig. 5, which lies below that of its Fig. 1 counterpart (i.e., $C^A(n_L)\hat{} < C^A(n_L)$). Finally, as shown in Fig. 5, a slight increase in surf gang territory increases the optimal surf gang size, in this case to $n_L*\hat{}$, relative to that of n_L* in Fig. 1 (i.e., $n_L*\hat{} > n_L*$). Thus,

[26] Unfortunately, documenting the scope, or existence, of pecuniary and in-kind rent seeking activity in this specific context is a virtually impossible task.

a larger surf gang is expected to emerge when acquisition of new surf gang territory occurs.

6 Concluding remarks

This study integrates some of the seminal public choice research on clubs and recent research on the formation and benefits of prison gangs into an analysis of the formation of surf gangs. More specifically, this study presents a model examining how surf break congestion, user-enforced informal property rights protection (i.e., localism), and surfing camaraderie work to determine the optimal size of a local surf gang. On the one hand, at the point of congestion at a given surf break, additional surfers contribute to negative congestion externalities. As such, surf breaks are much like other common-property resources, and the optimal size of a surf gang is bounded from above.

At the same time, surfing is a social activity whose benefits are enhanced in the presence of friends and associates. Thus, the benefits of surfing in groups are also influenced by camaraderie, which means that the optimal surf gang size is bounded away from one. Moreover, the effect of camaraderie is compounded by the fact that as the number of surf gang members increases, the fixed costs of localism effort (i.e. user-enforced property rights protection) aimed at non-local surfers fall on a per-member basis. The optimal size of a surf gang is determined by minimizing the aggregate of the types of costs mentioned above, and it lies at a point beyond where surfing camaraderie begins to give way to surf break congestion.

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