

# Comparison of Size of Capture Using Hook and Line, Fish Traps and Gill Nets of Five Species of Commercial Fish in Puerto Rico During 1988-1990

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## ABSTRACT

Puerto Rico's fishery is artisanal, multispecies, multigear and shows a number of indications of overfishing (e. g., markedly decreased reported landings since the early 1980s, and changes in species catch composition). To further evaluate resource status and to enable the development of effective resource management, size frequency data by species and by gear type were collected.

Port Agents of the Biostatistics Program of the Fisheries Research Laboratory (Puerto Rico Department of Natural Resources) randomly selected complete landings, identified all fish by species, took fork length measurements (in millimeters) and weights (in grams). Approximately 60,000 fishes caught by commercial fishermen were measured around the 42 coastal municipalities of the Island of Puerto Rico during 1988-1990, inclusive. Five of the most frequently-reported species were used for examination of size frequency data: *Haemulon plumieri*, *Lutjanus synagris*, *L. vivanus*, *Ocyurus chrysurus* and *Epinephelus guttatus*. Comparison of length frequency distributions by species, by gear type (hook and line, fish trap and gill net) and by coast were made using the Kolmogorov-Smirnov test.

Results showed that for *H. plumieri* and *L. synagris*, gill nets and hook and line caught significantly larger fish than fish traps. A higher percentage of fish was caught prior to sexual maturity by fish traps for *L. vivanus* (90% of total measured fish), *O. chrysurus*, (37% total measured fish) and *E. guttatus* (31% of total measured fish) than by either hook and line or gill net. In general, smaller individuals of each species for a given gear type were taken on the south coast than on the other coasts. The data indicate that certain recommendations regarding gear modifications may be made to reduce the capture of juvenile, or particularly small individuals of certain important species.

KEY WORDS: Commercial fisheries, hook and line, gill net, fish trap.

## INTRODUCTION

The Fisheries Research Laboratory (FRL) of the Department of Natural Resources of Puerto Rico is an institution that monitors the status of fisheries resources of Puerto Rico. The FRL Statistics Division collects information on commercial fisheries landings from ninety-two fishing centers in the forty-two coastal municipalities of Puerto Rico, including Vieques and Culebra. This information is based on the voluntary cooperation of commercial fishermen.

Three types of information are collected by the Statistics Division: a) landings (total reported pounds of fish and shellfish landed by species and by location; b) biostatistics (identification of intact catches by species, measured by length and weight); and c) census of the fishery (number of active fishermen, vessels and gears).

Since the early 1980s a marked decrease in most commercial species of fish and shellfish has been observed in Puerto Rico's reported landings data. Several management plans are currently in effect in both state and federal waters (spiny lobster plan) or in federal waters (Nassau grouper, yellowtail snapper minimum size restrictions).

Puerto Rico's fishery is artisanal, multispecies and multigear. Each gear exploits the resource in a different way producing a different species composition and different sizes of individuals. To better evaluate resource status and to more effectively develop resource management plan it is necessary to understand the effect of gear type on catch profile. The objectives of this investigation were: 1) to compare length frequency distributions (LFD) of commercial captures in Puerto Rico for five commercial fish species using biostatistical data collected from 1988-1990 for hook and line, fish traps and gill nets, and by coast; and 2) to determine the percentage of individuals taken below estimated size at sexual maturity by species and gear.

#### METHODS

Five port agents of the FRL Statistics Division visited island fishing centers, identified all species in intact catches and measured fork length (FL) in millimeters of each caught fish. Approximately 60,000 fish comprising 140 different species were measured. The five most frequently reported species were the white grunt, *Haemulon plumieri*, lane snapper, *Lutjanus synagris*, silk snapper, *Lutjanus vivanus*, yellowtail snapper, *Ocyurus chrysurus*, and red hind, *Epinephelus guttatus*.

Comparisons of LFD of each of these species caught by hook and line, fish trap and gill net (including trammel nets data) were made. LFD data were compared statistically using the Kolmogorov-Smirnov Two Sample Test (Sokal and Rohlf, 1981). No comparative analyses between gears and/or coasts were made when the number of fish measured (n) was < 50.

The north coast is defined as extending from Isabela to Luquillo, the east coast from Fajardo to Maunabo (including the islands of Vieques and Culebra), the south coast from Patillas to Lajas, and the west coast from Cabo Rojo to Aguadilla (Figure 1).

The percentage of individuals taken that fell below the estimated mean or minimum size of sexual maturation (MSSM) was determined irrespective of sex. MSSM was selected from Román (1991) for *Haemulon plumieri*, Boardman and



Weiler (1979) for *Lutjanus vivanus*, Thompson and Munro (1983a) for *Lutjanus synagris* and Thompson and Munro (1983b) for *Epinephelus guttatus*.

## RESULTS

### Length Frequency Distribution by Gear

*Haemulon plumieri* taken by hook and line and by gill net were significantly larger than those taken by fish traps in 1988,  $d_{max} = 0.2524$  and  $d_{max} = 0.1301$  (Figure 2). For the same year, the mean size of capture (FL), for all coast combined was 233 mm for hook and line, 228 mm for gill nets and 216 mm for fish traps. This pattern was similar for 1989 and 1990.

*Lutjanus synagris* taken by gill nets were significantly larger than those taken by other gears studied ( $d_{max} = 0.1107$  and  $d_{max} = 0.3005$ ), and individuals taken by hook and line were significantly larger than those taken by fish traps. Figure 3 shows the LFD for all coasts separately by gear type in 1989. For 1989 the mean FL of capture for all coasts was 230 mm for hook and line, 265 mm for gill nets and 224 mm for fish traps. The pattern was similar for 1988 and 1990.

*Lutjanus vivanus* taken by hook and line were significantly larger than those taken by fish trap ( $d_{max} = 0.0775$ ). Due to the fact that this species lives in deep water, no gill net captures were reported. Figure 4 shows the LFD for hook and line and fish trap, for all coasts in 1989. This year (1991) the mean FL of captured individuals for all coasts was 306 mm for hook and line and 246 mm for fish trap. The pattern was similar for 1988 and 1990.

*Ocyurus chrysurus* taken by hook and line were significantly larger than those taken by gill nets and fish traps ( $d_{max} = 0.2954$  and  $d_{max} = 0.1532$ ). Figure 5 shows the LFD for all coasts separately by gear type in 1990. This year (1991) the mean FL of captured individuals for all coasts was 283 mm for hook and line, 237 mm for gill nets, and 232 mm for fish traps. The pattern was similar for 1988 and 1989.

*Epinephelus guttatus* taken by hook and line were significantly larger than those taken by fish trap ( $d_{max} = 0.1474$ ). Figure 6 shows the LFD for hook and line and fish trap for all coasts in 1990. This year (1991) the mean FL of captured individuals was 295 mm for hook and line and 270 mm for fish traps. The pattern was similar for 1988 and 1989. Due to the fact that gill nets do not usually take *Epinephelus guttatus*, reports for this species taken by gill net were less than 50 for all years studied.

### Length Frequency Distribution by Coast

Individuals taken from the south coast were generally smaller than those taken on other coasts. Figure 7 shows the LFD of *Haemulon plumieri* taken by gill nets on the east and south coasts in 1990. South coast individuals were significantly smaller than those from the east coast. Figure 8 shows the LFD of *Lutjanus synagris* taken by fish trap on west, south, and north coasts in 1990.

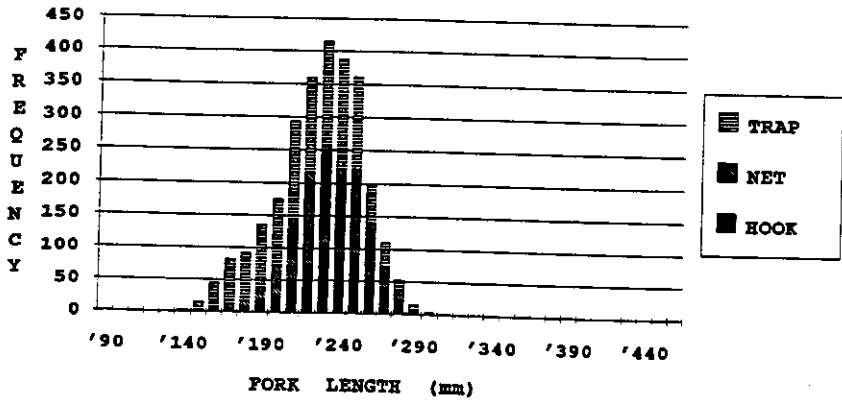


Figure 2. Length frequency distributions for *Haemulon plumieri* taken by hook and line, gill net, and fish traps, all coasts combined, during 1988.

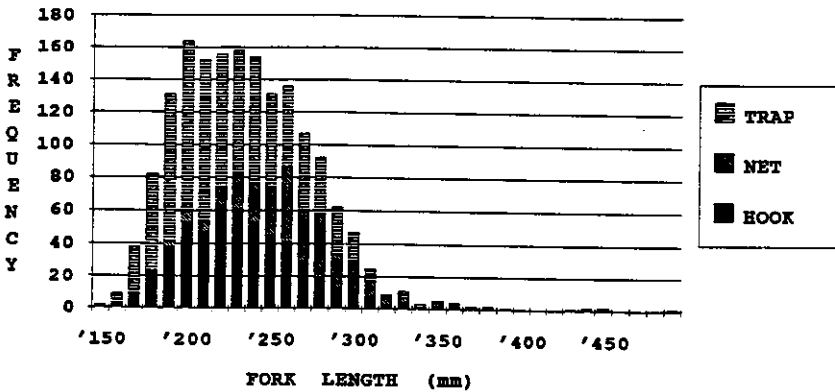


Figure 3. Length frequency distributions for *Lutjanus synagris* taken by hook and line, gill net, and fish traps, all coasts combined, during 1989.

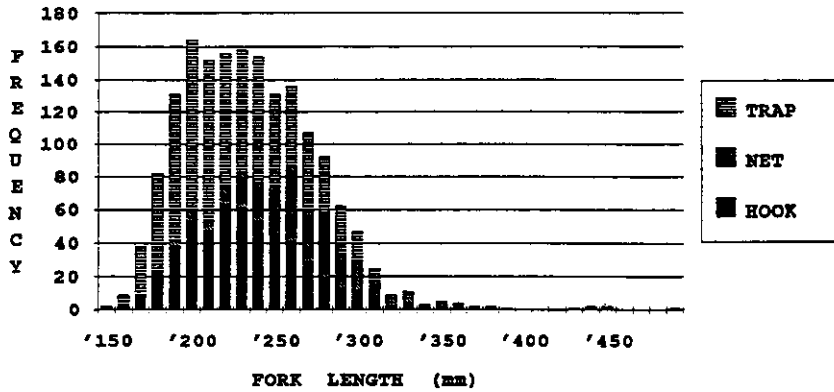


Figure 4. Length frequency distributions for *Lutjanus vivanus* taken by hook and line, gill net, and fish traps, all coasts combined, during 1989.

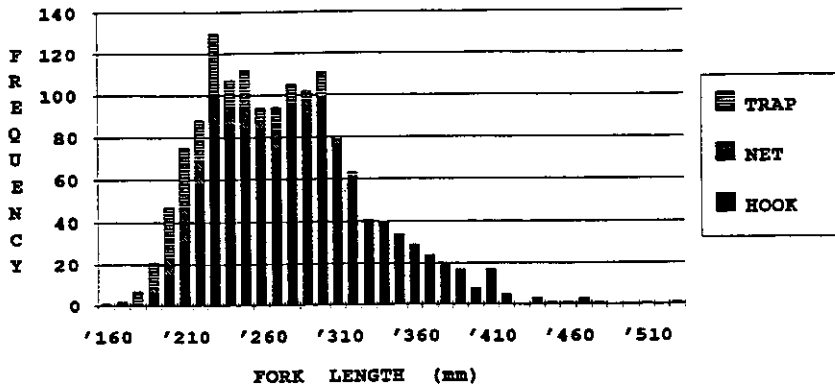


Figure 5. Length frequency distributions for *Ocyurus chrysurus* taken by hook and line, gill net, and fish traps, all coasts combined, during 1990.

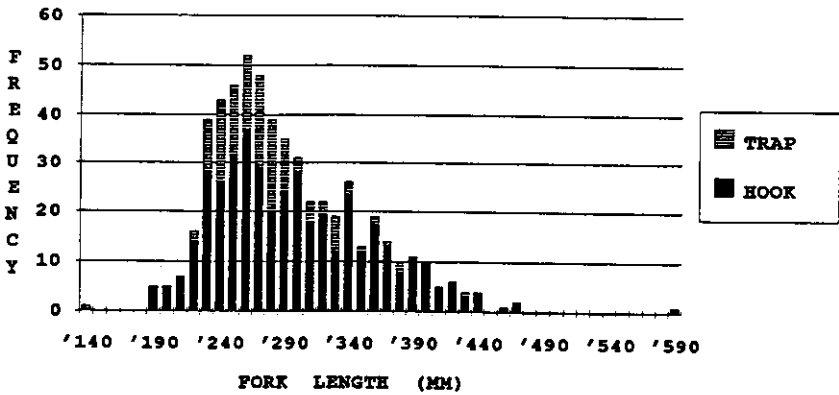


Figure 6. Length frequency distributions for *Epinephelus guttatus* taken by hook and line, gill net, and fish traps, all coasts combined, during 1990.

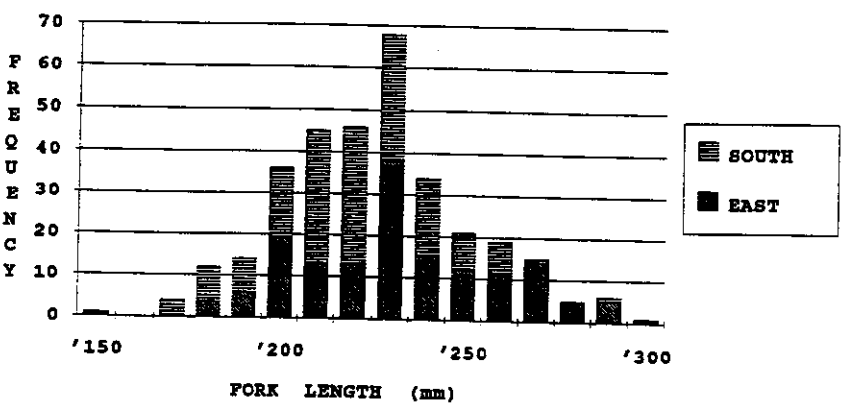


Figure 7. Length frequency distributions for *Haemulon plumieri* taken by gill net from east and south coasts in 1990.

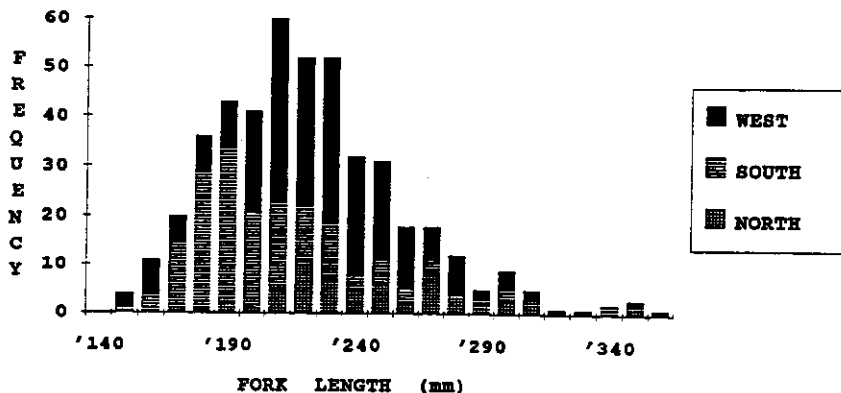


Figure 8. Length frequency distributions for *Lutjanus synagris* taken by fish trap from west, south, and north coasts in 1990.

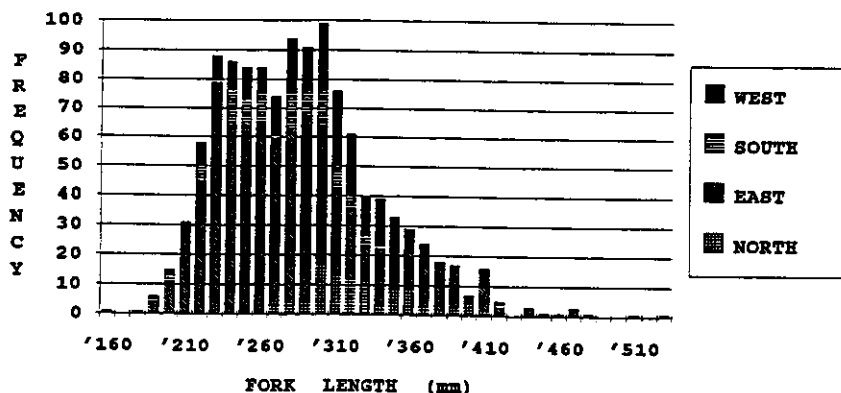


Figure 9. Length frequency distributions for *Ocyurus chrysurus* taken by hook and line from all coasts combined, in 1990.



Fish taken on the north and west coasts were significantly larger than those from the south coast. Figure 9 shows the LFD of *Ocyurus chrysurus* for each coast taken by hook and line in 1990. Individuals taken from the north and west coasts were significantly larger than those from the south and east coasts. Size frequency distributions for all coasts combined and separately for 1988, 1989 and 1990 are shown for *Haemulon plumieri* (Figure 10) and *Epinephelus guttatus* (Figure 11).

#### Individuals Taken Below the Estimated Size of Sexual Maturity

Table 1 shows the percentages of individuals taken below the approximate mean or minimum size of sexual maturity (MSSM) for each species. Fish traps generally caught relatively more sexually immature individuals for all species studied than other gears. The greatest percentage of juveniles for any one species was over 90% for *Lutjanus vivanus* taken by fish trap for all three years and over 90% for hook and line for 1988 and 1990. *Ocyurus chrysurus* and *Epinephelus guttatus* were taken in relatively high numbers as juveniles by all gears, particularly by fish trap. *Haemulon plumieri* and *Lutjanus synagris* had low percentages of non-sexually mature fish taken by all three gear types.

### DISCUSSION

#### Gear Type

Fish traps caught smaller fishes than other gears for all studied species. Fish traps are the most used gear in Puerto Rico, accounting for approximately 33% (by weight) of Puerto Rico's reported landings during 1988 and 1990. Ten years ago (in 1978) fish traps reported approximately 52% (by weight) of the total island landings. Recently, fish trappers in Puerto Rico have reported decreasing trap catches on a per-haul basis, and many have been forced to increase the number of traps they deploy to maintain captures.

Hook and line capture shows a tendency to take larger fishes for all species studied. This gear accounted for approximately 22% (by weight) of the total island landings reported during 1988-1990. Fishermen should be motivated to increase the use of hook and line and reduce the use of fish traps if reduction of the capture of immature individuals of certain key species is to be achieved.

Gill nets show a tendency to catch fishes larger than those taken by fish traps for three species that were reported from gear and larger than those taken by hook and line for *Lutjanus synagris*.

#### Coasts

Smaller individuals tend to be taken on the south than on other coasts. Possible reasons for this are: a) fishermen on the south coast generally fish in shallower waters than fishermen on other coasts; b) this coast is more heavily fished by fish traps or other gears than other coasts, removing more small fish;

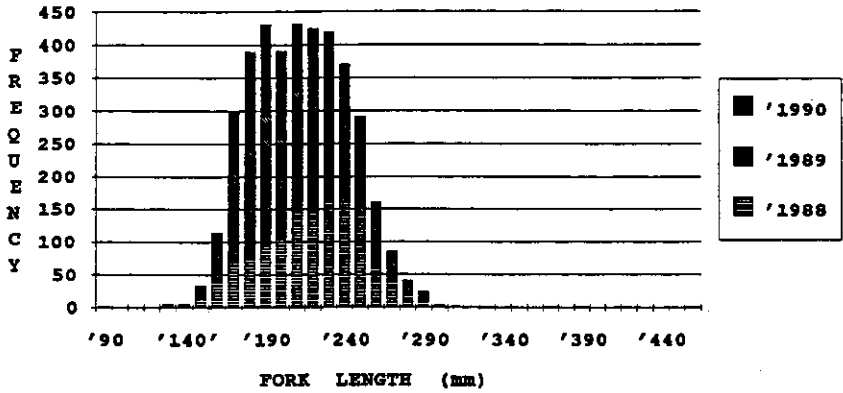


Figure 10. Length frequency distributions for *Haemulon plumeri* taken by fish trap, all coasts combined, during 1988-1990.

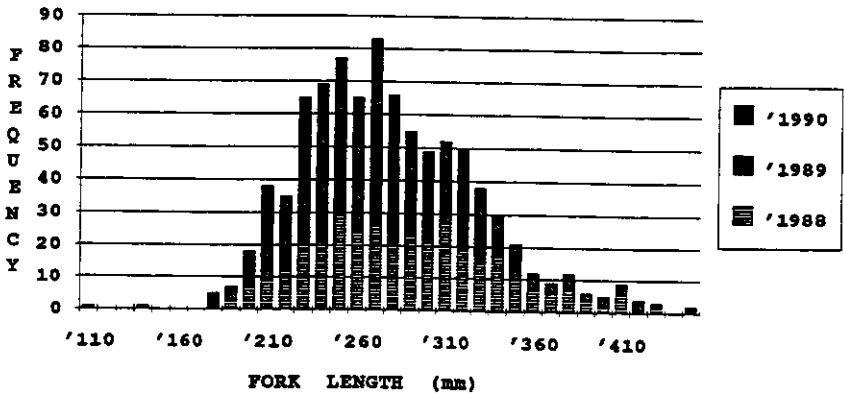


Figure 11. Length frequency distributions for *Epinephelus guttatus* taken by fish trap, all coasts combined, during 1988-1990.

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**Table 1.** Percentage of individuals taken below the approximate mean or minimum size of sexual maturation, fork length (\*\*\*) n < 50).

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***Haemulon plumeri***

Minimum size of sexual maturity = 160 mm

Gear / Year	1988	1989	1990
Hook and Line	0.80	0.70	0.14
Gill Net	2.20	6.10	0.30
Fish Trap	9.60	11.80	5.10

***Lutjanus synagris***

Approximate mean size of sexual maturity = 180 mm

Gear / Year	1988	1989	1990
Hook and Line	5.90	2.30	0.80
Gill Net	0.30	0.00	22.00
Fish Trap	3.90	4.10	15.00

***Lutjanus vivanus***

Approximate minimum size of sexual maturity = 380 mm

Gear / Year	1988	1989	1990
Hook and Line	94.80	75.00	94.30
Gill Net	***	***	***
Fish Trap	98.60	98.60	95.60

***Ocyurus chrysurus***

Approximate mean size of sexual maturity = 260 mm

Gear / Year	1988	1989	1990
Hook and Line	39.10	35.70	38.20
Gill Net	26.30	26.30	76.60
Fish Trap	58.20	71.20	77.70

***Epinephelus guttatus***

Approximate minimum size of sexual maturity = 250 mm

Gear / Year	1988	1989	1990
Hook and Line	23.10	36.70	27.60
Gill Net	***	***	***
Fish Trap	29.50	32.90	33.60

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and c) there may be natural size differences because of factors such as variation in food availability between coasts. These various possible explanations need to be investigated to understand observed differences.

#### Individuals Taken Below the Estimated Size of Sexual Maturity

Relatively few individuals of *Haemulon plumieri* and *Lutjanus synagris* were taken below MSSM. However, *Lutjanus vivanus* showed an alarmingly high percentage of individuals taken below MSSM during the three years for both gears. This species is highly valued economically in Puerto Rico and is heavily exploited. The need for action to protect sexually immature individuals of this species is recommended.

Approximately 37% of *Ocyurus chrysurus* (all gears and all years combined) were caught before reaching MSSM. Fish traps took approximately 69% below MSSM. Currently, the CFMC has a management plan in federal waters to protect this species. The plan prohibits capture below a catch size (254 mm FL in 1988, 279 mm FL in 1989, and 304 mm in 1990). Approximately 53% in 1988, 70% in 1989, and 26% in 1990 of individuals of this species were caught below the minimum catch size established by the federal management plan in both state and federal waters.

*Epinephelus guttatus* shows a relatively high percentage of individuals taken below the MSSM. It has been proposed to protect the seasonal spawning aggregation of this species, since the species is very vulnerable to heavy fishing pressure, during this period. Such protective measures and others requiring gear modification are likely necessary to maintain or increase yield.

#### ACKNOWLEDGEMENTS

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