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ILLINOIS NATURAL HISTORY SURVEY

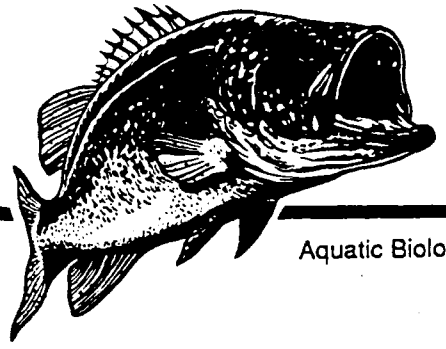
A SPORT FISHING CREEL SURVEY OF THE ILLINOIS PORTION OF LAKE MICHIGAN

1 April 1985 through 31 March 1986

Aquatic Biology Section Technical Report

by

William H. Horns
and
Robert W. Gorden



Aquatic Biology Technical Report 1986(3)

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Final Report

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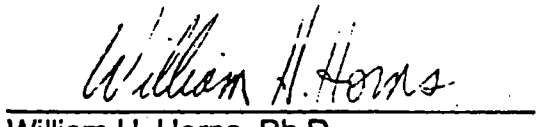
Aquatic Biology Section
Illinois Natural History Survey

to

Division of Fisheries
Illinois Department of Conservation



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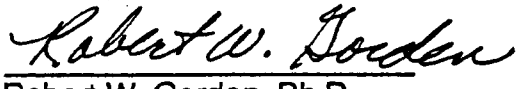

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Principal Investigator and Section Head

July 1986

A Sport Fishing Creel Survey of the Illinois Portion of Lake Michigan (AFS-4) was conducted under a memorandum of understanding between the Illinois Department of Conservation and the Board of Trustees of the University of Illinois. The actual research was performed by the Illinois Natural History Survey, a division of the Department of Energy and Natural Resources. The project was supported by funds from the U.S. Fish and Wildlife Service and the Illinois Department of Conservation through Anadromous Fish funding and the Illinois Natural History Survey. The form, content, and data interpretations made in this report are the responsibility of the University of Illinois and the Natural History Survey, and not that of the Illinois Department of Conservation.

INTRODUCTION

On 31 March 1986, we completed the first year of a continuing creel survey of sport fishing in the Illinois portion of Lake Michigan. This creel survey covers all sport fishing in the Illinois waters of the Lake, with the exception of charter-boat fishing. We are interested in the following components of the sport fishery: *summer fishing* (including pedestrian angling, fishing from launched boats, and fishing from boats kept at moorings), *smelt fishing*, *snagging*, and *winter fishing* (including ice fishing and fishing in power plant discharge areas).

The general intent of the project is to provide reliable estimates of sport fishing activity, sport fish harvest, expenditures for sport fishing, and the quality of sport fishing. During the first year, several specific objectives were pursued (see *Summary of Objectives*). This creel survey is the first of its type since 1979, when Bruce Muench conducted a survey of summer fishing in the Illinois portion of Lake Michigan (Muench 1981).

METHODS

Summer Fishing

Summer fishing was divided into: pedestrian angling, fishing from launched boats, and fishing from boats kept at moorings. In 1985, we identified 25 sport fishing sites along the Illinois shore (Figure 1) where one or more of the preceding categories of fishing took place. In addition, pedestrians fished at scattered locations between the 25 defined sites. We surveyed summer fishing from 1 April through 27 October 1985.

In our survey of pedestrian angling and fishing from launched boats, data collection focused on *primary sites*, with auxiliary information gathered from other sites. This approach maximizes precision in estimates for the primary sites but may admit substantial bias in estimates elsewhere. In 1985, the primary pedestrian sites were Waukegan and Montrose Harbors (representing 35% of all pedestrian angling in the

Illinois portion of Lake Michigan) and the primary launch sites were Waukegan and Diversey Harbors (representing 56% of launched boats).

Data were collected using the *Interview Form* (Figure 2) and the *Instantaneous Count Form* (Figure 3). The use of these forms, as modified slightly for 1986, is discussed in detail in Appendix 1. *Major* expenses included expenditures for boats, motors, or trailers. During summer 1985, *minor* expenses included rods, reels, downriggers, lines, lures, bait, licenses, boat rental, launching fees, boat gas and oil, boat maintenance, automobile gas, and lodging, food, alcohol, and clothing for the trip. *Other* expenditures included anything not defined as minor or major expenditures. Because anglers almost never reported other expenditures, no estimates were made of daily or seasonal total expenditures in this category.

For each primary site, the sampling unit was the calendar day, with estimates of effort, catch, and expenditures formed for each randomly selected day. Dates were randomly selected in a stratified design. Strata were defined by first dividing the total sampling period into sub-intervals of about 1 month each and then forming weekday and weekend (including holidays) strata within each time interval. Time intervals were identified with abbreviated names of months, although they did not correspond exactly to calendar months. The intervals were:

apr = 1 April - 12 May (6 weeks)
may = 13 May - 9 June (4 weeks)
jun = 10 June - 7 July (4 weeks)
jul = 8 July - 4 August (4 weeks)
aug = 5 August - 1 September (4 weeks)
sep = 2 September - 29 September (4 weeks)
oct = 30 September - 27 October (4 weeks)

Using the *Interview Form*, we conducted interview sets of approximately 2 hours each with pedestrian anglers at the primary sites and with boating anglers returning to the primary launch ramps. Associated with each pedestrian interview set was a count

of the number of pedestrian anglers at the site, providing a basis for estimating the total number of angler-hours at that site for the day. Associated with each launch ramp interview set was a count of the number of trailers in the parking lot. This count, together with the number of boating anglers returning during the interview period, provided a basis for estimating the total number of boat fishing trips from that ramp for the day. *Catch/angler-hour* (by species), *catch/boat trip* (by species), major and minor *expenditures/angler*, and major and minor *expenditures/boat trip* were derived from data recorded in interview sets.

Daily Effort

The total *number of angler-hours* by pedestrian anglers at a particular site during a survey date was estimated from the number of anglers counted, using the estimated average daily fishing patterns (Figure 4). The numbers so derived were not greatly different from what would have been derived simply by multiplying the number of counted anglers by the number of hours in the fishing day (a fishing day was from 0.5 hour before sunrise to 0.5 hour after sunset). The total *number of pedestrian anglers* was estimated by dividing the total number of angler-hours by the average duration of a trip. The estimated total *number of angling boats* was the number of angling boats returning to the ramp during the 2-hour interview period multipled by a factor that depended on the time of day of the interview set. The multiplier was based on an estimated average distribution of boat returns (Table 1). Estimates of total numbers of angling boats were found to be highly variable and often unrealistically high or low. To provide more reliable estimates, daily records of the number of launch passes sold at Waukegan Harbor (obtained from Mr. Thomas Silva, Waukegan Port District) were used, assuming that the number of passes was related to the number of fishing boats launched from the primary sites. To determine those relationships, initial estimates of numbers of angling boats were regressed against numbers of daily launch passes sold at Waukegan Harbor. The best-fitting straight lines (Figure 5) were then used to estimate, for any particular day, the total number of angling boats.

Daily Catch

Total catch (by species) at a site on a particular day was estimated by multiplying catch/angler-hour by the total number of angler-hours (for pedestrians) or by multiplying catch/boat trip by the total number of angling boats (for boaters).

Daily Expenditures

Total daily expenditures (major and minor) were estimated for boaters by multiplying the average expenditure/boat trip by the total number of angling boats, and for pedestrians by multiplying the number of pedestrian anglers by the average expenditure/angler.

Expenditures for major items were reported infrequently to our clerks. Therefore, the statistical methods outlined here as applied to those data may not have provided reliable estimates. Estimates of major expenditures in Table 2 and Figure 6 should be regarded with skepticism. They are excluded from *Results*.

Seasonal Totals for Primary Sites

Estimates of seasonal totals of effort, catch, and expenditures at the primary sites were derived from daily estimates using methods described by Cochran (1977) for stratified random samples. Within each stratum (*e.g.*, 1 April-12 May weekends, 1 April-12 May weekdays), the daily estimates derived for effort, catch, and expenditures were averaged; the averages were multiplied by the number of days in the stratum to estimate the total effort, catch, and expenditures within each stratum. The within-stratum estimates were summed to give estimates of total effort, catch, and expenditures for the summer. Estimates of standard deviations of the seasonal totals also follow Cochran (1977), except that no finite population correction factor was applied. An approximate 95% confidence interval around each seasonal total was determined by taking the estimated total plus or minus twice the estimated standard deviation of the seasonal total. Confidence intervals are shown in the figures.

Extrapolation to Other Sites

Estimates from the primary sites were extrapolated to all sites using estimated geographic distributions of pedestrian and boating anglers. The distribution of pedestrian fishing was estimated during several *comprehensive counts*, when teams of creel clerks visited all 25 sites simultaneously (with a 2-hour period) to count pedestrian anglers and boat trailers. On other occasions, helicopter flights were used to count all anglers and trailers. The helicopter flights provided estimates of the numbers of pedestrians at locations between the 25 designated sites (Figure 7).

Pedestrians. Seasonal estimates for pedestrian fishing in Waukegan and Montrose Harbors were extrapolated to all pedestrian fishing areas; Waukegan Harbor estimates were applied to *northern* pedestrians (*i.e.*, pedestrian fishing in or north of Wilmette) and Montrose Harbor estimates were applied to *southern* pedestrians (*i.e.*, pedestrian fishing south of Wilmette). For those extrapolations, seasonal estimates of total effort, catch, or expenditures at Waukegan Harbor were multipled by 2.22 to estimate all northern sites (45% of northern pedestrians were at Waukegan Harbor) and those at Montrose Harbor by 3.13 (32% of southern pedestrians were at Montrose Harbor).

Boaters. Seasonal estimates for launched-boat fishing from Waukegan and Diversey Harbors were extrapolated to all launched fishing boats. Waukegan Harbor estimates were applied to boats launched north of Wilmette, and Diversey Harbor estimates were applied to all boats launched south of Wilmette. Waukegan Harbor was the site of approximately 73% of all boats launched north of Wilmette; Diversey Harbor was the site of approximately 32% of all boats launched elsewhere in Illinois waters.

Extrapolation to Moored Boats

The launched-boat estimates were extrapolated to estimate catch and expenditures by anglers using boats kept at moorings. The implicit assumption was that catch rates

and expenditures were similar for launched and moored boats. (We conducted a postal survey of fishing from boats moored in Waukegan Harbor and the Chicago Park District, but the response was inadequate.) These extrapolations were based on:

(1) The ratio of moored to launched fishing boats returning to Waukegan Harbor. On 15 occasions, a clerk monitored all boats returning to Waukegan Harbor for 2 hours; 95 fishing boats returned to moorings for every 100 fishing boats returning to the launch ramps. Thus, seasonal estimates for moored boats in Waukegan Harbor were derived by multiplying estimates for the launched boats by 0.95.

(2) The ratio of moored to launched fishing boats returning to Diversey Harbor. A multiplier of 2.89 was derived for Diversey Harbor by a similar means (based on 14 2-hour observation periods).

(3) The proportion of moored boats kept in those two harbors. Of moored power boats kept in Waukegan Harbor, the Great Lakes Naval Training Station, or Wilmette, 66% were kept in Waukegan Harbor. Similarly, 35% of moored power boats kept in Chicago were kept in Diversey Harbor. (These estimates exclude private moorings.) These percentages were used to extrapolate the estimates for moored-boat fishing for Waukegan and Diversey Harbors to the remainder of the moored boats, assuming that the fraction of power boats used for fishing was the same at all harbors.

Smelt Fishing

We interviewed 749 smelt fishermen in a survey that was similar in design to that used for pedestrian and boat angling; on randomly selected nights, a creel clerk visited sites on the Lake, counted the smelt fishermen, and interviewed them. The smelt fishery is difficult to survey because (1) it is conducted in darkness, so fishermen cannot be quickly counted, and (2) it is subject to dramatic and rapid changes in fishing quality (catch/effort ranged from 50 smelt/net to less than 1 smelt/net per hour over a 1-week period).

Snagging

Methods used to survey snagging were similar to those used to survey summer pedestrian fishing. Legal snagging takes place at six sites in Illinois: Waukegan Power Plant (8.2% of the total), Waukegan Harbor (16.3%), Winnetka Power Plant (Tower Park in Figure 1, 7%), Northwestern University (6.3%), Diversey Harbor (38.3%), and Jackson Park (23.7%) (Figure 8). Legal snagging began 1 October and over 90% of the legal snagging occurred during October; thus, estimates pertain only to that month.

Winter Fishing

The winter fishing survey covered five ice-fishing locations (Jackson Park, Burnham Harbor, Belmont Harbor, Montrose Harbor, and Diversey Harbor) and one power plant (Waukegan). The five ice-fishing sites comprise essentially all ice fishing in Illinois waters of Lake Michigan. The only other significant site for winter power plant fishing is Winnetka Power Plant (Tower Park), which is visited by about one-third as many anglers as the Waukegan Power Plant. Methods used to survey winter fishing were similar to those described for summer fishing.

RESULTS

Activity

1985 Summer Fishing

Pedestrian anglers made approximately 88,000 fishing trips to Montrose Harbor and 40,000 trips to Waukegan Harbor during 1985 (Figure 9). Those two locations accounted for approximately 35% of all pedestrian fishing on the Lake; therefore, the estimated total number of pedestrian fishing trips was 366,000. Approximately 3,700 fishing boats were launched from Diversey Harbor and 13,300 were launched from Waukegan Harbor (Figure 10). Because those two harbors accounted for approximately 56% of all launched boats, the estimated total number of fishing trips using launched boats was 30,000. For every 100 fishing boats launched at Diversey

Harbor, 289 set out from moorings; for every 100 fishing boats launched at Waukegan Harbor, 95 set out from moorings. The estimated total number of fishing trips using moored boats kept in those two harbors was 23,000. Those two harbors accounted for approximately 44% of all moored power boats, resulting in an estimated 52,000 fishing trips from boats kept at moorings.

1985 Smelt Fishing

Smelt fishermen made approximately 70,000 fishing trips to Lake Michigan.

1985 Snagging

Snaggers made approximately 15,000 trips to legal snagging areas (Figure 8).

1986 Winter Fishing

Approximately 5,200 fishing trips were made to the Waukegan power plant during January, February, and March. Fishing pressure at the Winnetka power plant was approximately 31% of that at Waukegan, so approximately 6,800 fishing trips were made to the two power plants during winter 1986. During the same period, approximately 3,200 trips were made for ice fishing to Jackson Park and Burnham, Belmont, Diversey, and Montrose Harbors.

Harvest

1985 Summer Fishing

Approximately 402,000 yellow perch, 650 rainbow trout, 75 lake trout, 9,200 coho salmon, 5,100 chinook salmon, and 600 brown trout were caught by pedestrian anglers at Waukegan and Montrose Harbors (Figures 11 and 12). Approximately 20,700 yellow perch, 970 rainbow trout, 1,400 lake trout, 24,200 coho salmon, 10,100 chinook salmon, and 480 brown trout were caught by fishermen using boats launched from Waukegan and Diversey Harbors (Figures 13 and 14). In total, approximately

1,300,000 yellow perch, 6,800 rainbow trout, 6,900 lake trout, 120,700 coho salmon, 57,400 chinook salmon, and 3,300 brown trout (Table 3) were harvested.

1985 Smelt Fishing

Total smelt harvest in 1985 was not estimated. On the 10 nights of the survey, catch/net per hour ranged from less than one fish to over 50 fish.

1985 Snagging

During October, snaggers at legal sites harvested approximately 6,000 chinook salmon and 600 coho salmon. Smaller numbers of rainbow trout and brown trout were caught (Figure 8). Snagging continued into November, but over 90% of the fall snagging took place in October.

1986 Winter Fishing

The approximate harvest during January, February, and March at the Waukegan power plant was 830 rainbow trout, 340 brown trout, and 180 coho salmon (Table 4). Because fishing pressure at the Winnetka power plant was approximately 0.31 times that at Waukegan, the estimated total power plant harvest was 1,100 rainbow trout, 450 brown trout, and 230 coho salmon. Almost all ice fishing took place at Jackson Park and Burnham, Belmont, Diversey, and Montrose Harbors. Approximately 18,000 yellow perch and 320 rainbow trout were caught through the ice at these locations (Table 5).

Expenditures

1985 Summer Fishing

Pedestrian anglers spent approximately $618,000 for minor items on trips to Waukegan and Montrose Harbors (Figure 15). Fishermen using boats launched from Diversey and Waukegan Harbors spent approximately $728,000 for minor items

(Figure 16). Therefore, for minor items (1) pedestrian anglers spent an estimated $1,800,000, (2) fishermen using launched boats $1,200,000, and (c) fishermen using moored boats $1,800,000. Minor items constituted essentially all reported expenditures except for boats, motors, and trailers.

1985 Smelt Fishing

Smelt fishermen spent approximately $420,000 during 1985.

1985 Snagging

During October 1985, snaggers spent approximately $103,000.

1986 Winter Fishing

Anglers at the Waukegan power plant spent approximately $39,500 during January, February, and March of 1986 (Table 4). At the Winnetka power plant, total expenditures were estimated to be $50,000. Ice fishermen spent approximately $11,000 during the same months (Table 5).

SUMMARY OF OBJECTIVES

Study 101. Major creel survey.

Objective 1. To design a stratified sampling procedure for a creel census of shore, pier, and breakwater fishermen.

This objective was expanded to include boat fishermen as well as pedestrians. The survey design is presented in detail in *Methods*. Each primary pedestrian site was visited on dates selected in a stratified random sample. For each date selected, estimates were made of daily catch, effort, and expenditures. Daily estimates were expanded to estimate seasonal totals using methods outlined by Cochran (1977). The

primary sites studied in 1985 were Waukegan and Montrose Harbors. These results were extrapolated to other sites, with the more northerly sites assumed to be similar to Waukegan Harbor and the more southerly sites to Montrose Harbor. Fishing from launched boats was similarly surveyed, with Waukegan and Diversey Harbors serving as the primary study sites. Estimates for launched-boat anglers were extrapolated to moored-boat anglers based on estimates of the proportions of fishing boats returning to launch ramps and moorings.

In 1986 the number of primary pedestrian sites will be expanded from two to six and the number of primary launch ramps from two to three.

Objective 2. To conduct a creel census of shore, pier, and breakwater fishermen.

Approximately 5,000 interviews with angling parties (both pedestrian and boating) were conducted. Pedestrian anglers and boat trailers were counted at 25 angling sites on 1,397 occasions, and 4,000 fish were weighed and measured (Figure 17-20).

Objective 3. To determine the reliability of aerial counts and of ground counts of fishermen.

Accurate counts of pedestrian anglers may be made either from the ground or air. Aerial counts of pedestrian anglers permit an entire shoreline to be quickly scanned and areas not easily and quickly visited by car to be viewed. A helicopter was used on three occasions to determine the number of anglers at locations not included in the 25 defined sites. Anglers at the 25 sites were counted quickly and economically by a team of three clerks in cars.

Aerial counts of fishing boats are probably unreliable, and they are too expensive to use frequently in a creel survey.

Objective 4. To determine the activity and harvest by organized fishing contest participants.

During 1985, eight tournaments (four shore and four boat) were scheduled in the Illinois portion of Lake Michigan. Because participants in these tournaments would be subject to the sampling schedule outlined above and because it is not possible to determine how much additional fishing was due to these tournaments, no special tournaments surveys were conducted. Participants in tournaments sponsored by Salmon Unlimited of Illinois reported a total catch of 1,657 salmonids (data provided by Glen DeVries, Tournament Committee Chairman), 0.8% of our estimated total non-charter sport catch.

Objective 5. To obtain an estimate of the activity of and harvest by smelt fishermen.

Although 749 smelt fishermen were interviewed in 1985, estimates of the smelt fishery were difficult to obtain because of darkness and rapidly changing fishing quality (see *Results*). In 1986, we will visit one primary site almost every night during the 6-week smelt season and collect additional data elsewhere when it is deemed that fishing is good.

Objective 6. To conduct a creel census of important winter fishing areas, including harbors and discharge canals.

Ice fishermen and winter power plant fishermen were interviewed in surveys that were similar to those conducted during summer months. On randomly selected days during January, February, and March 1986, a creel clerk visited sites on the Lake, counted the fishermen, and interviewed them. Five principal ice fishing sites were selected: Jackson Park and Belmont, Burnham, Diversey, and Montrose Harbors; 127 angling parties were interviewed at these locations. At Waukegan power plant, 130 angling parties were interviewed.

Objective 7. To determine the extent of sport fishing from boats launched from key sites.

See objectives 1 and 2.

Objective 8. To accurately enter and process data generated in jobs 1 through 7.

Data were recorded in the field on an *Interview Form* (Figure 2) and an *Instantaneous Count Form* (Figure 3). Details on the use of those forms (as modified slightly for 1986) are presented in Appendix 1. Data were recorded on floppy disks using the software package RBASE 5000 and an IBM PC computer. Data were reduced and summarized with RBASE 5000 and specially written BASIC programs. Data were analyzed using LOTUS 1-2-3.

Objective 9. To evaluate the amount and distribution of fishing effort by type, location, and season.

This objective was achieved in connection with data collection. Results are summarized above and in the tables and figures.

Study 102. Socio-economic survey.

Objective 1. To determine the economic value of the Lake Michigan sport fishery in Illinois.

Questions about expenditures were included in all interviews with angling parties. Fishing parties were asked their expenditures for *major* (boats, motors, and trailers), *minor* (rods, reels, downriggers, lines, lures, bait, licenses, boat rental, launching fees, boat gas and oil, boat maintenance, automobile gas, lodging, food, alcohol, and clothing) and *other* (anything not included as major or minor) items. Estimates of total expenditures by all anglers were made (Table 2).

Objective 2. To determine the recreational value and yield value of the angler's catch.

The yield value may be defined as the market value of the pounds of fish harvested by anglers (Table 6). The recreational value is the estimated sum of major and minor expenditures as discussed in Objective 1 (Table 2).

Objective 3. To assess the economic and social value of the Lake Michigan sport fishery for Illinois.

During 1985, under funding from the Illinois-Indiana Sea Grant Program, a postal survey of economic and social aspects of the Lake Michigan sport fishery was conducted under the direction of Dr. James D. Absher, University of Illinois. Because that survey addressed a number of the economic and social questions raised in the proposal for the present creel survey, we chose not to duplicate those efforts. Results of the Sea Grant survey may be combined with our results to evaluate the economic and social value of the Lake Michigan sport fishery for Illinois.

LITERATURE CITED

Cochran, W. G. 1977. Sampling techniques, 3rd ed. John Wiley and Sons, New York.

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ACKNOWLEDGMENTS

This survey was performed under contract from the Illinois Department of Conservation. Rich Hess and Bruce Muench provided advice and direction for the survey. The Waukegan Port District and the Chicago Park District provided information for the postal surveys of fishing from moored boats. Salmon Unlimited of Illinois provided data from its tournaments. Susan Malmer, Peter Senese, Susan Darrow, and John Reinke were the creel clerks for the survey. Administrative and budget assistance were provided by Jana Waite and Sue Hale of the Illinois Natural History Survey.

Table 1. Daily pattern of boat returns to Waukegan and Diversey Harbors. On 7 days (4 days at Waukegan and 3 days at Diversey Harbors), all fishing boats returning to a launch ramp were monitored. Average percentages returning at 1-hour intervals are shown here.

Time interval	Percentage of boats returning to Waukegan Harbor	Percentage of boats returning to Diversey Harbor
sunrise - 0700	1	0
0700 - 0800	1	0
0800 - 0900	3	6
0900 - 1000	4	4
1000 - 1100	9	12
1100 - 1200	20	18
1200 - 1300	18	11
1300 - 1400	18	12
1400 - 1500	14	10
1500 - 1600	3	8
1600 - 1700	1	6
1700 - 1800	4	8
1800 - sunset	3	6
all day	100	100

Table 2. Estimated expenditures (in dollars) by fishermen from 1 April through 27 October 1985. Minor expenditures included rods, reels, downriggers, lines, lures, bait, licenses, boat rental, launching fees, boat gas and oil, boat maintenance, automobile gas, and lodging, food, alcohol, and clothing needed for the trip. Major expenditures included boats, motors, and trailers. Most values are extrapolations from data collected from pedestrians at Waukegan and Montrose Harbors and from boaters at Waukegan and Diversey Harbors and must be used with caution.

Fishermen	Expenditures	
	Minor	Major
Pedestrians		
Waukegan Harbor	192,000	*
Montrose Harbor	426,000	*
Elsewhere[a]	1,148,000	*
Boaters (launched)		
Waukegan Harbor	611,000	764,000
Diversey Harbor	117,000	364,000
Elsewhere[b]	475,000	1,058,000
Boaters (moored)		
Waukegan Harbor[c]	580,000	726,000
Diversey Harbor[d]	338,000	1,052,000
Other[e]	931,000	2,334,000
Total	4,818,000	6,298,000

[a] Estimates developed for pedestrian anglers at Waukegan and Montrose Harbors were extrapolated to all other sites. The Waukegan Harbor estimates were extrapolated to anglers from Winnetka north to the Wisconsin state line. The Montrose Harbor estimates were extrapolated to anglers south of Winnetka.

[b] Estimates derived from launched-boat anglers using Waukegan and Diversey Harbors were extrapolated to all other launched boats. Waukegan Harbor estimates were extrapolated to anglers from Winnetka north to the Wisconsin state line. The Diversey Harbor estimates were extrapolated to anglers south of Winnetka.

[c] Estimates derived for launched boat anglers at Waukegan Harbor were extrapolated to anglers using moored boats based on the estimated ratio of moored boat anglers to launched boat anglers at Waukegan Harbor (0.95).

[d] Estimates derived for launched boat anglers at Diversey Harbor were extrapolated to anglers using moored boats based on the estimated ratio of moored boat anglers to launched boat anglers at Diversey Harbor (2.89).

[e] Estimates derived for moored boat anglers at Waukegan and Diversey Harbors were again extrapolated, with Waukegan Harbor estimates applied to moored boats at the Great Lakes Naval Training Station and Winnetka and Diversey Harbor results applied to all boats moored in Chicago.

Table 3. Estimated sport fish harvest by fishermen from 1 April through 27 October 1985. Most numbers are extrapolations from estimates made for pedestrian anglers at Waukegan and Montrose Harbors and for launched boat anglers using Waukegan and Diversey Harbors. Confidence intervals are wide and the relationships used in the extrapolations are estimates of unspecified accuracy, so these numbers should be used with caution. See Table 2 for extrapolation procedures.

Fishermen	Yellow perch	Rainbow trout	Lake trout	Coho salmon	Chinook salmon	Brown trout
Pedestrians						
Waukegan	95,685	182	0	5,442	2,537	517
Montrose	306,688	470	75	3,758	2,585	70
Elsewhere[a]	775,158	1,231	161	14,665	8,628	776
Boaters (launched)						
Waukegan	13,171	706	1,098	20,913	8,285	420
Diversey	7,520	262	314	3,335	1,786	64
Elsewhere[b]	20,891	819	1,075	14,841	6,870	292
Boaters (moored)						
Waukegan[c]	12,512	671	1,043	19,867	7,871	399
Diversey[d]	21,733	757	907	9,638	5,162	185
Other[e]	46,929	1,757	2,230	28,258	13,693	552
Total	1,300,288	6,855	6,904	120,717	57,416	3,274

Table 4. Harvest and expenditures by winter fishermen at the Waukegan power plant (1 January through 31 March 1986); it represented the primary power plant winter fishing area. The only other power plant fishing available to pedestrians in Illinois was the Winnetka power plant. During five visits, we found that the number of anglers at Winnetka averaged 31% of the number at Waukegan.

Month	Number of fish harvested			Expenses ($)
	Rainbow trout	Brown trout	Coho salmon	
January	168	108	0	7,891
February	105	235	0	6,864
March	553	0	179	24,814
Total	826±204	343±142	179±194	39,569±28,598

Table 5. Estimated total ice fishing catch and minor expenditures from 1 January through 31 March 1986. The five sites cover essentially all ice fishing in Illinois waters of Lake Michigan. No other fish species were caught in significant numbers.

	Yellow perch	Rainbow trout	Expenses ($)
Jackson Park	0	60	642
Burnham Harbor	3,280	0	2,976
Belmont Harbor	9,555	86	2,624
Montrose Harbor	5,227	145	3,488
Diversey Harbor	29	36	1,092
Total	18,091±7,150	328±172	10,882±2,658

Table 6. Estimated summer yield values of six fish species. For each species, total estimated catch (from Table 3) is multiplied by the average weight of all measured fish to give an estimate of harvested weight, which is then multiplied by 0.67 to approximate the total weight of edible flesh (rounded to the nearest 1,000 pounds). Edible weight is multiplied by a market value ($8/pound for yellow perch and $4/pound for salmonids) to give the yield value.

Species	Catch	Harvested weight (pounds)	Edible weight (pounds)	Yield value ($)
Yellow perch	1,300,288	325,000	217,000	1,726,000
Coho salmon	120,717	471,000	314,000	1,256,000
Chinook salmon	57,416	488,000	325,000	1,300,000
Lake trout	6,904	49,000	33,000	132,000
Rainbow trout	6,855	28,000	19,000	76,000
Brown trout	3,274	12,000	8,000	32,000
Total				4,532,000

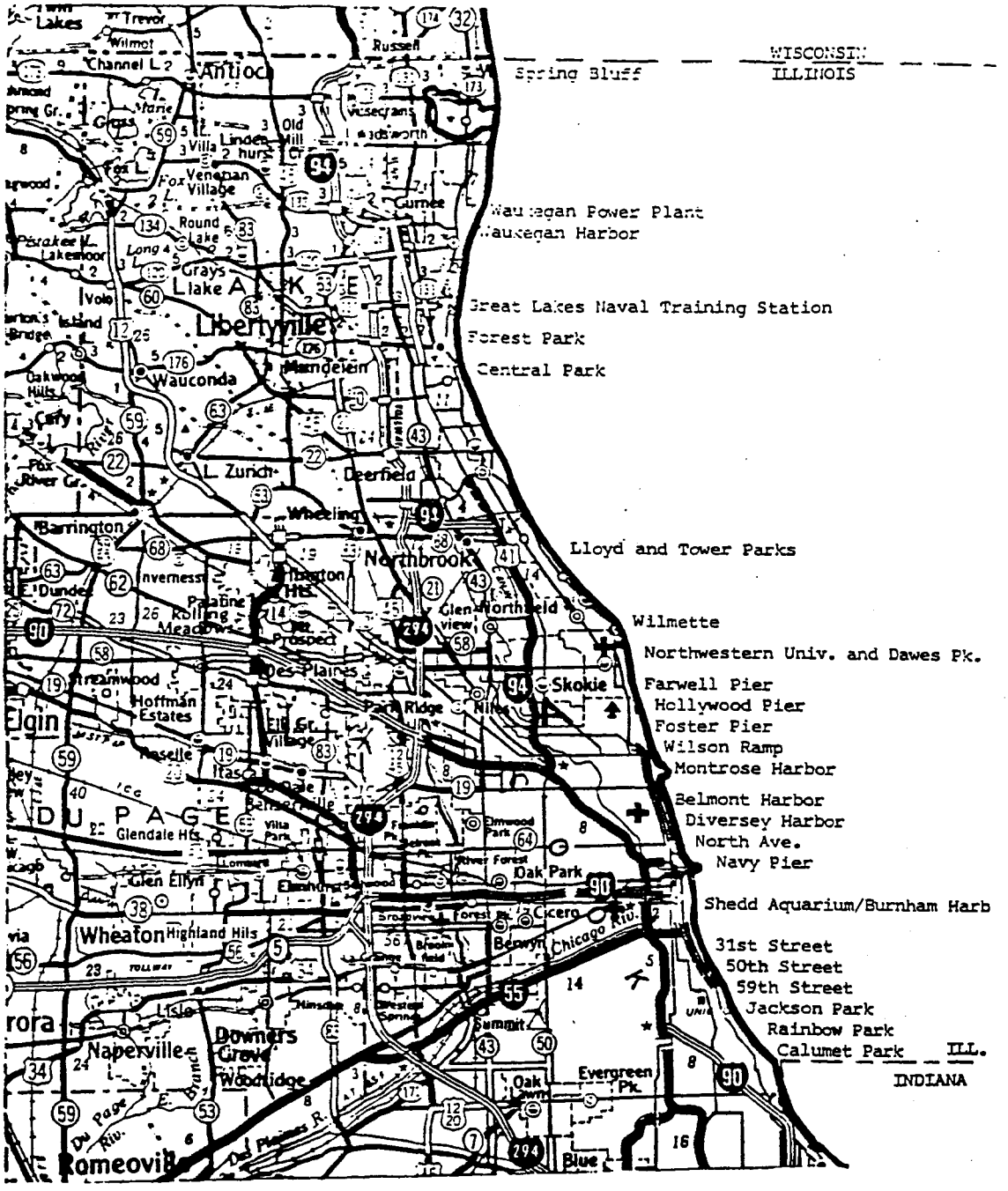

Figure 1. Map of the Illinois shoreline with the 25 fishing sites designated.

INTERVIEW FORM 6/1/86

REPORTER ______ LOCATION ______

DATE ___ ___ ___
M D Y

PAGE ______ OF ______

SITE DATA	TIME	REGULAR PEDS			SPECIAL PEDS			TRAILERS
		HAR	SHO	STR	SNA	SMT	ICE	
START								
FINISH								

PARTY RECORD														CATCH RECORD											
ID	ANGLER TYPE (CIRCLE ONE)	# ANGS		# LINES		# NETS		TRIP TIMES			EXPENSES ($)			SOUGHT	NUMBERS IN POSSESSION										% TIME NON-ILL
		TOT	RES	ROD	PWR	GILL	DIP	BEG	INTER-VIEW	END	MAJ	MIN	OTHER		BK	BN	RB	LT	CO	CH	YP	SM	NP	OTHER	
	HAR SHO STR LAU SNA SMT ICE MOO																								
	HAR SHO STR LAU SNA SMT ICE MOO																								
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	HAR SHO STR LAU SNA SMT ICE MOO																								

Figure 2. Interview form.

TIME (start time of interview set): _____

FISH RECORD						
ID	SPECIES	WEIGHT (g)	LENGTH (cm)	CLIPPED FINS	# SCARS	# WOUNDS

FISH RECORD						
ID	SPECIES	WEIGHT (g)	LENGTH (cm)	CLIPPED FINS	# SCARS	# WOUNDS

Figure 3. Instantaneous count form. This particular form is the one used in 1986, which includes two sites (Monroe and McCormick) not included in the 1985 creel survey. reporter _____ date ___ ___ ___ (m d y)

site	time	USUAL SITES regular peds harb	shor	stru	special peds snag	smelt	ice	trailers	ANGLERS IN VICINITY #	location	type
Spring Bluff											
Waukegan Power											
Waukegan Harbor											
Great Lakes											
Forest Pk											
Central Pk											
Lloyd and Tower											
Wilmette											
NWU and Dawes											
Farwell											
Hollywood											
Foster											
Wilson											
Montrose											
Belmont											
Diversey											
North Ave.											
Navy Pier											
Monroe											
Shedd and Burnham											
McCormick											
31st St.											
50th St.											
59th St.											
Jackson											
Rainbow											
Calumet											

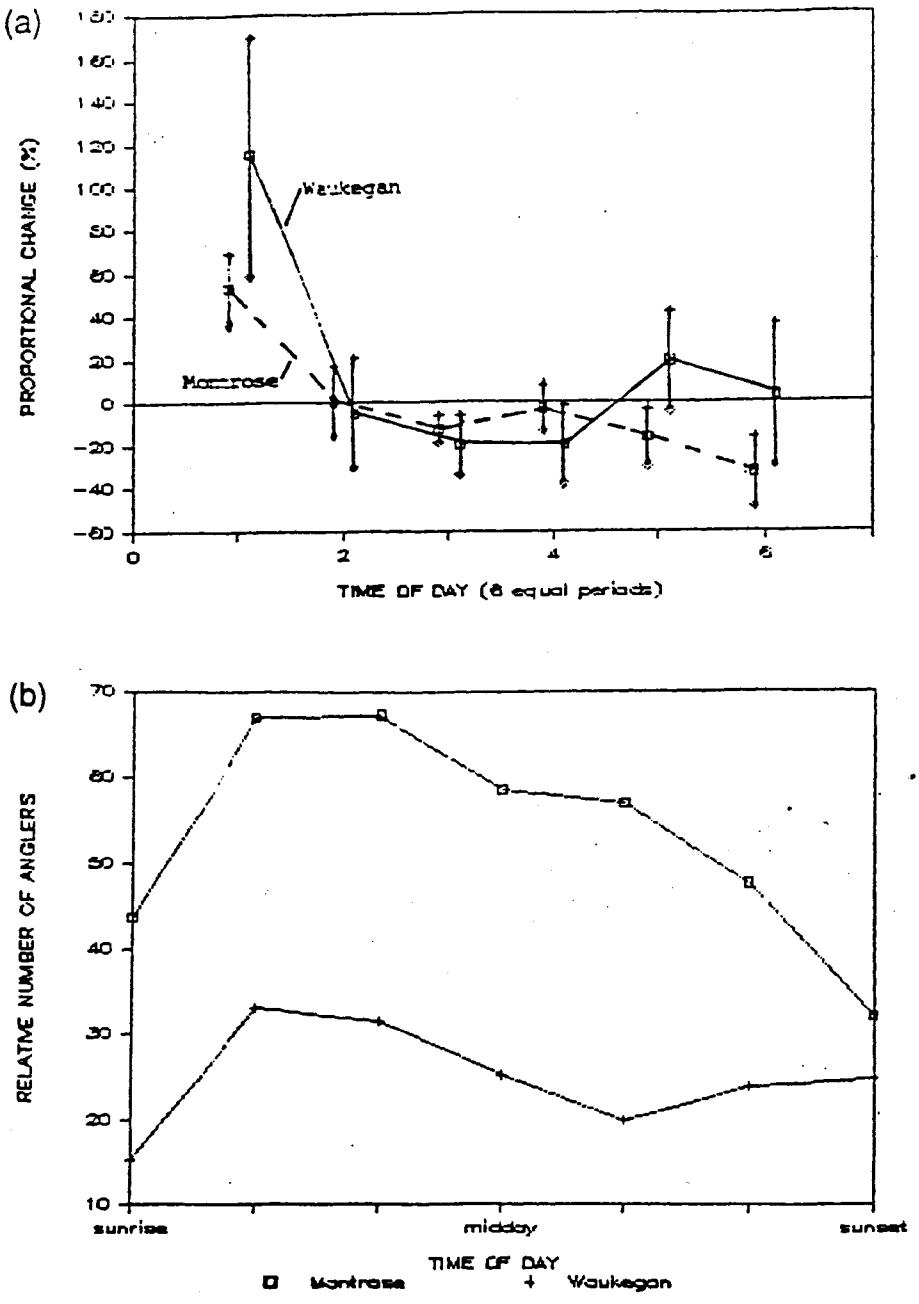

Figure 4. Fishing patterns at Montrose and Waukegan harbors. The fishing day (0.5 hour before sunrise to 0.5 hour after sunset) was divided into six intervals. Numerous counts of anglers were used to derive these numbers. (a) Averages of proportional changes in numbers of anglers are indicated for each time interval. These rates were used to derive (b). (b) The number of anglers is arbitrary but the ratio of the total numbers of anglers at the two sites conforms to our observations. The main difference between the two sites is that the number of anglers steadily declined toward evening at Montrose Harbor, while evening fishing was relatively popular at Waukegan Harbor.

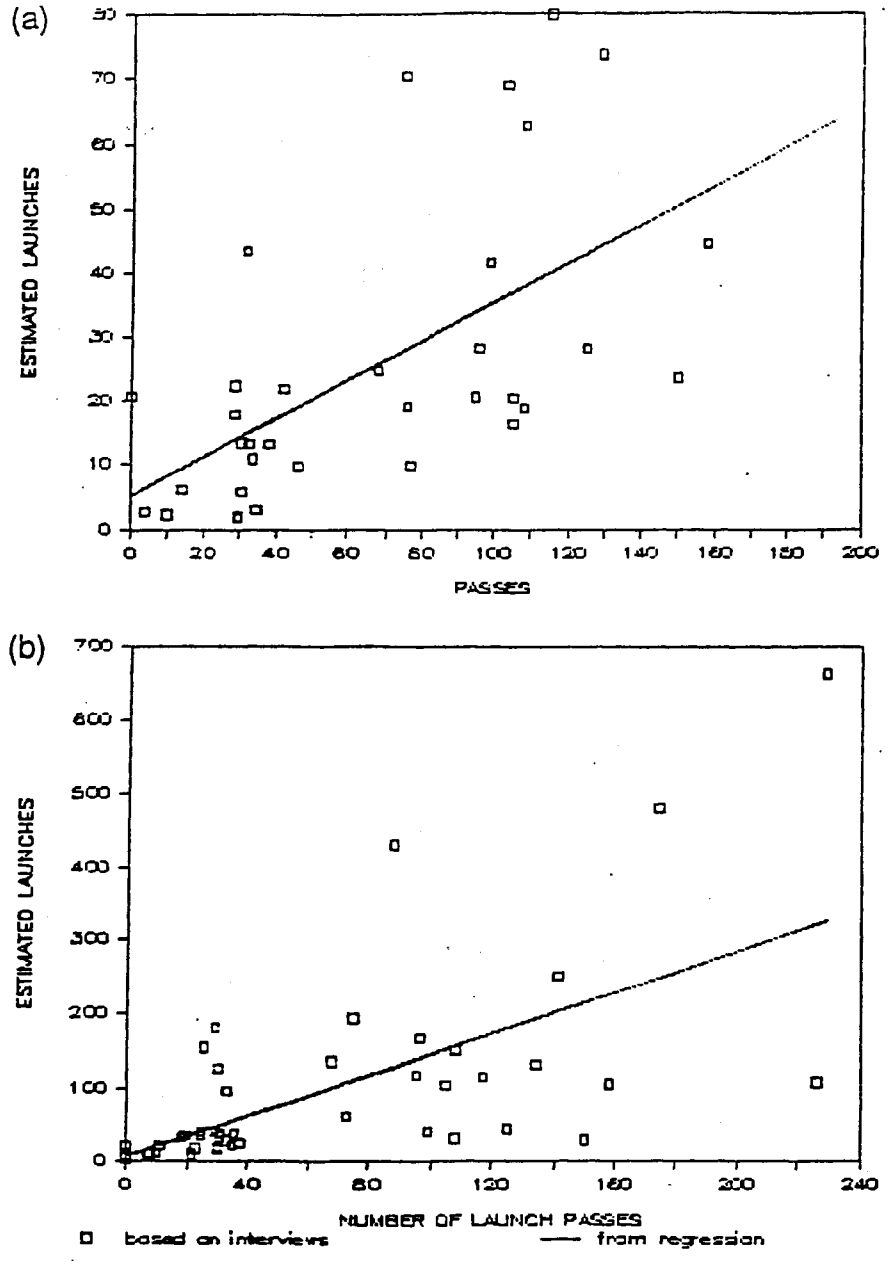

Figure 5. Estimates of the number of launched fishing boats at (a) Diversey and (b) Waukegan Harbors. Estimates derived from interval counts of returning anglers were plotted against the number of daily launch passes sold at Waukegan Harbor. Estimates from interval counts were unsatisfactory because they often gave unrealistic values. The best fitting straight line was then used to derive estimates of the numbers of launched fishing boats at the two sites.

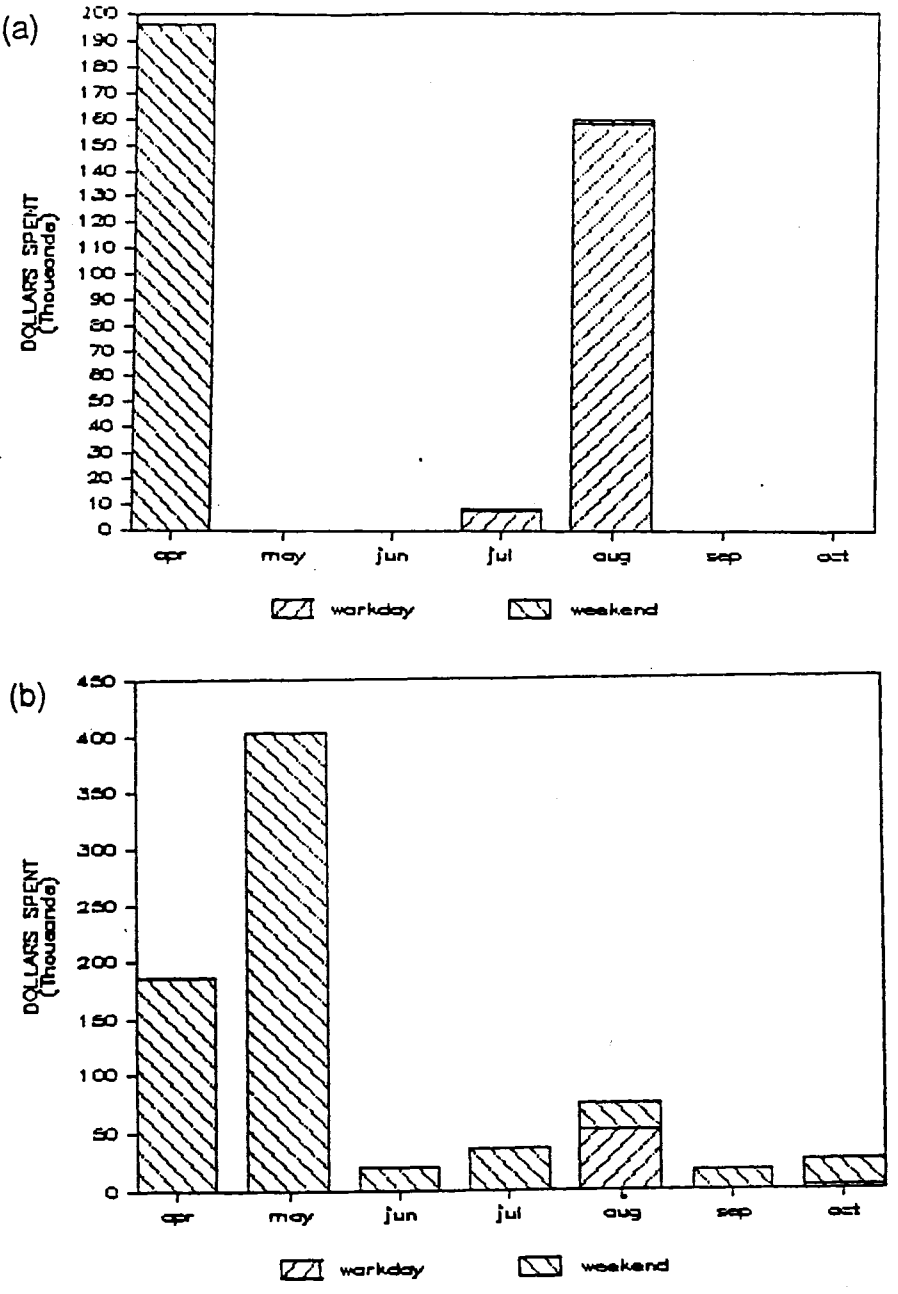

Figure 6. Estimated major expenditures by fishermen using boats launched from (a) Diversey and (b) Waukegan Harbors in 1985. From 1 April to 27 October 1985, fishermen using Diversey Harbor spent approximately $364,000 and those using Waukegan Harbor $764,000.

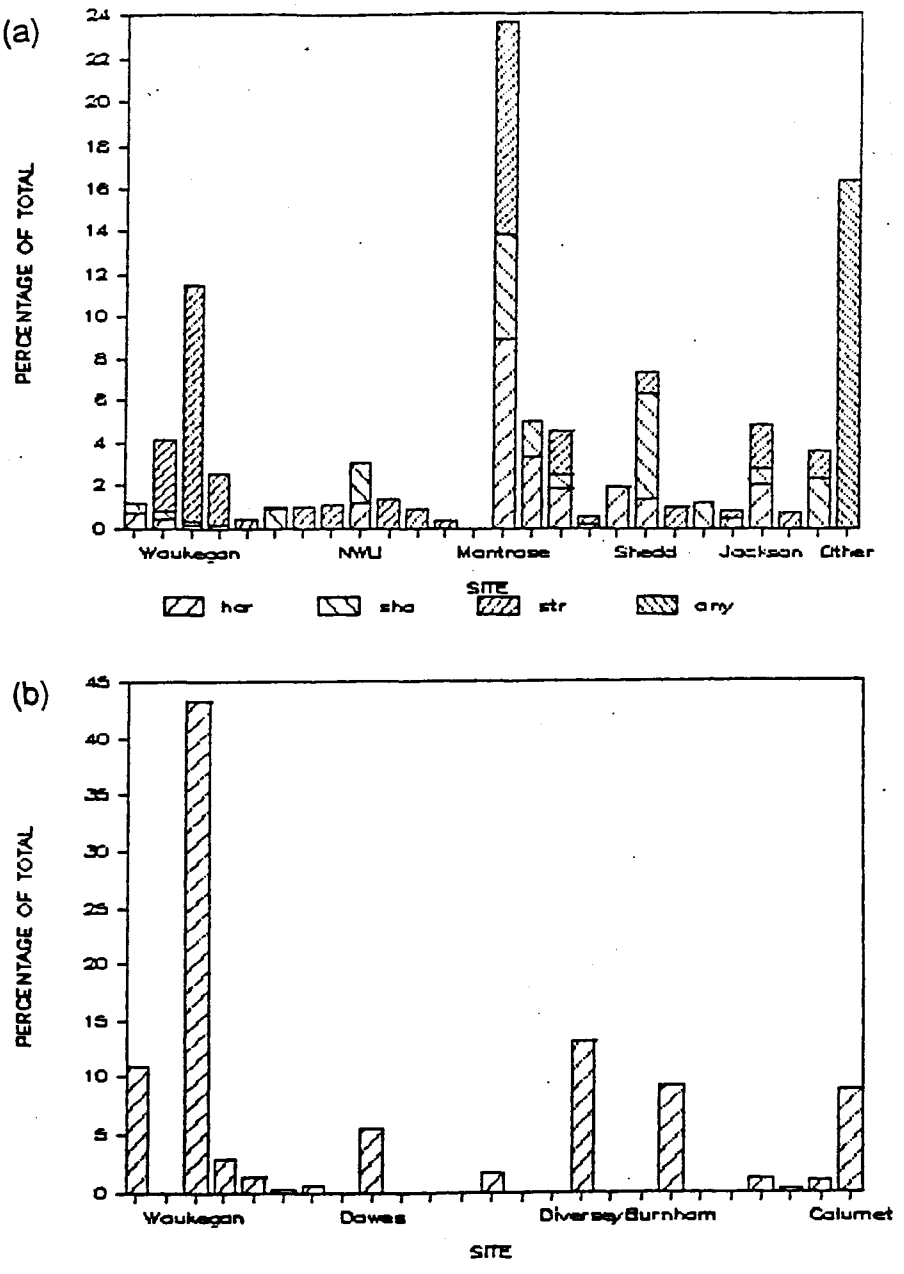

Figure 7. Distribution of fishing according to the 25 defined sites. The bars are arranged in geographic order, with the left-most bar corresponding to the most northerly site, Spring Bluff. (a) Distribution of pedestrian anglers as determined by comprehensive counts and helicopter flights. Each pedestrian angling area was subdivided into areas defined as harbor, shore, and structure. Approximately 16% of the pedestrian anglers fished in areas not included among the 25 sites. Most extra areas were "shore," although they are here classified as "any." (b) Distribution of boat trailers was also determined from helicopter flights. This distribution approximately reflects that of launched fishing boats.

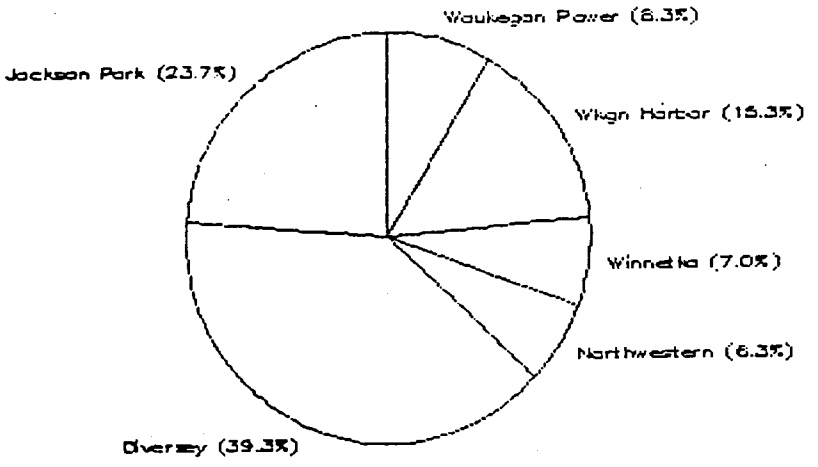

Figure 8. Distribution of snag fishing in Illinois waters of Lake Michigan. During October 1985, anglers spent approximately $103,000 for snagging in the six legal area. Approximately 6,000 chinook salmon were harvested, representing 86% of the snagging harvest. Smaller numbers of coho salmon (9%), rainbow trout (4%), and brown trout (<1%) were also caught. Snagging continued into November, but over 90% of the snagging occurred in October.

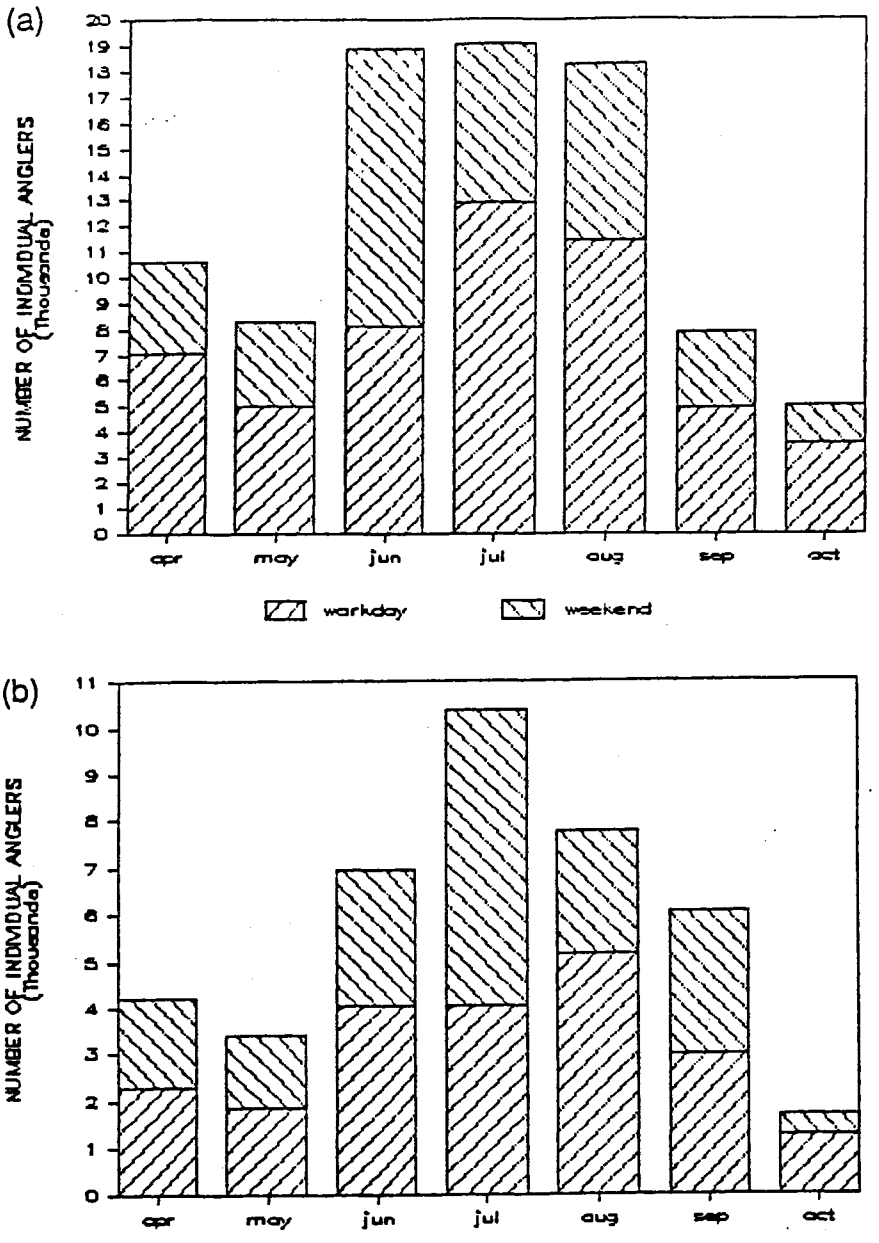

Figure 9. Estimated numbers of angling trips at (a) Montrose and (b) Waukegan Harbors. Between 1 April and 27 October 1985, approximately 88,000 anglers visited Montrose Harbor and 40,000 Waukegan Harbor. Totals are divided into approximate monthly intervals (see *Methods* for precise dates) and by type of day. The *Apr* time interval was 6 weeks; all others were 4 weeks long.

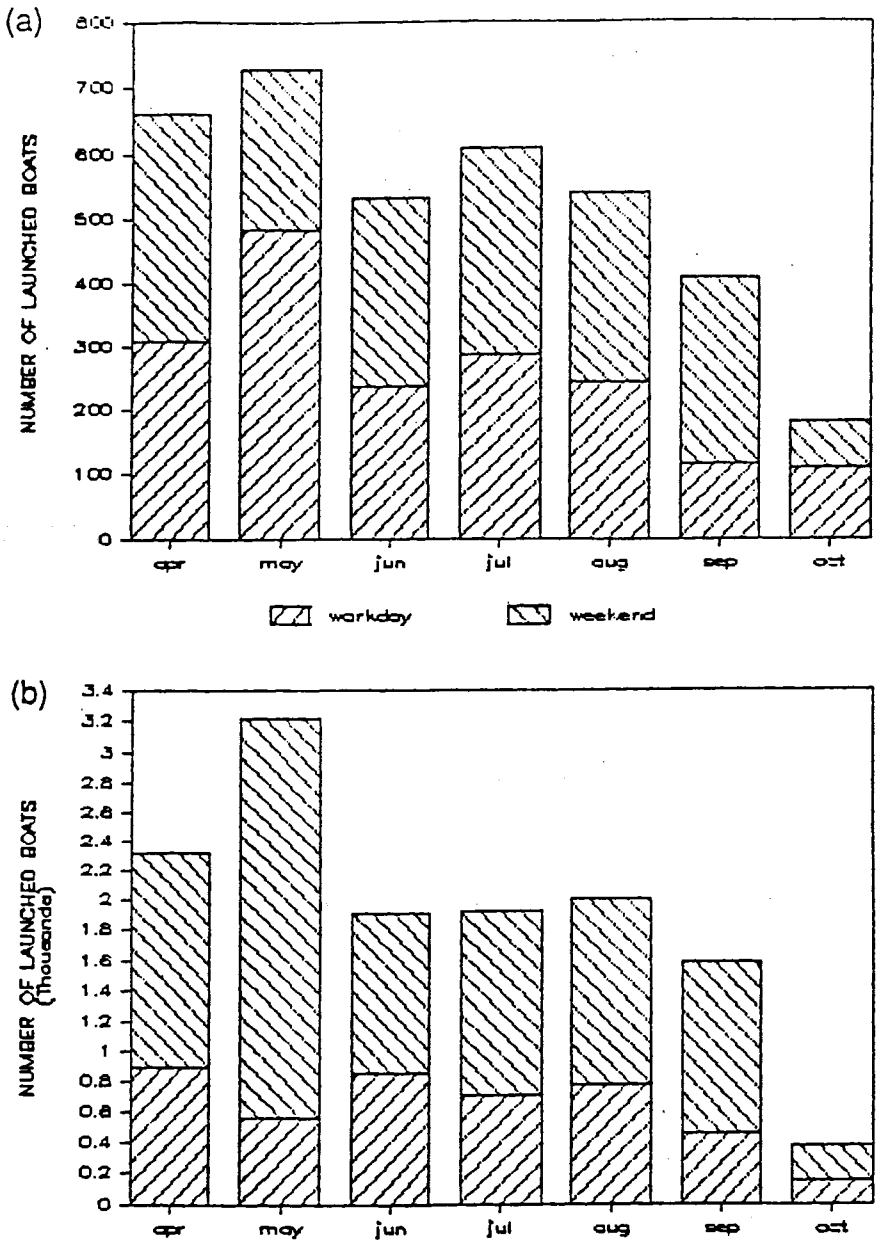

Figure 10. Estimated numbers of angling boats launched from (a) Diversey and (b) Waukegan Harbors. Between 1 April and 27 October 1985, approximately 3,668 boats were launched from Diversey Harbor and 13,331 from Waukegan Harbor. Totals are divided into approximate monthly intervals (see *Methods* for precise dates) and by type of day. The *Apr* time interval was 6 weeks; all others were 4 weeks long.

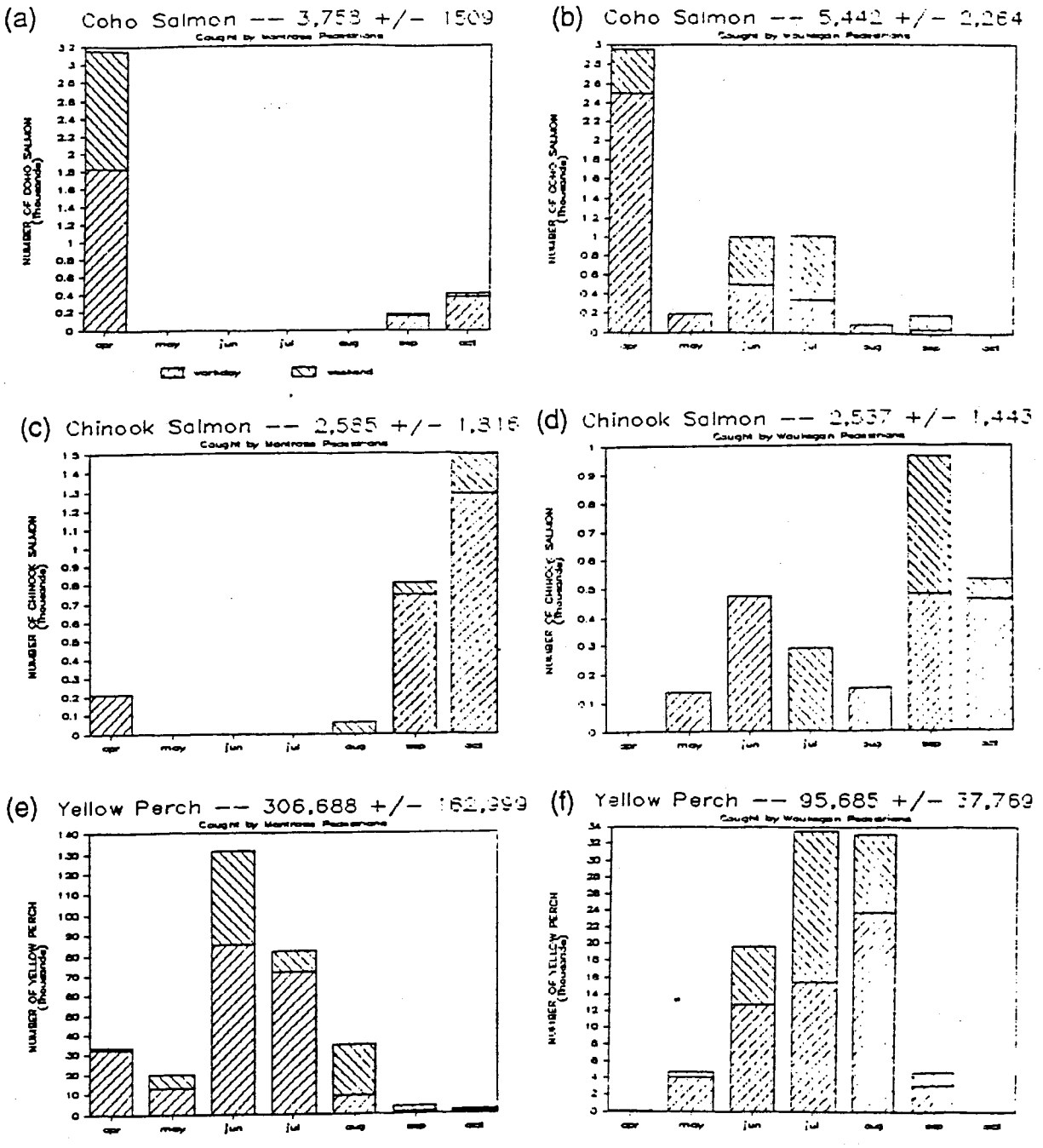

Figure 11. Estimated total catches of six species by pedestrian anglers fishing at Montrose and Waukegan Harbors, 1 April-27 October 1985. Totals are divided into approximate monthly intervals (see *Methods* for precise dates) and by type of day. The *Apr* time interval was 6 weeks; all others were 4 weeks long.

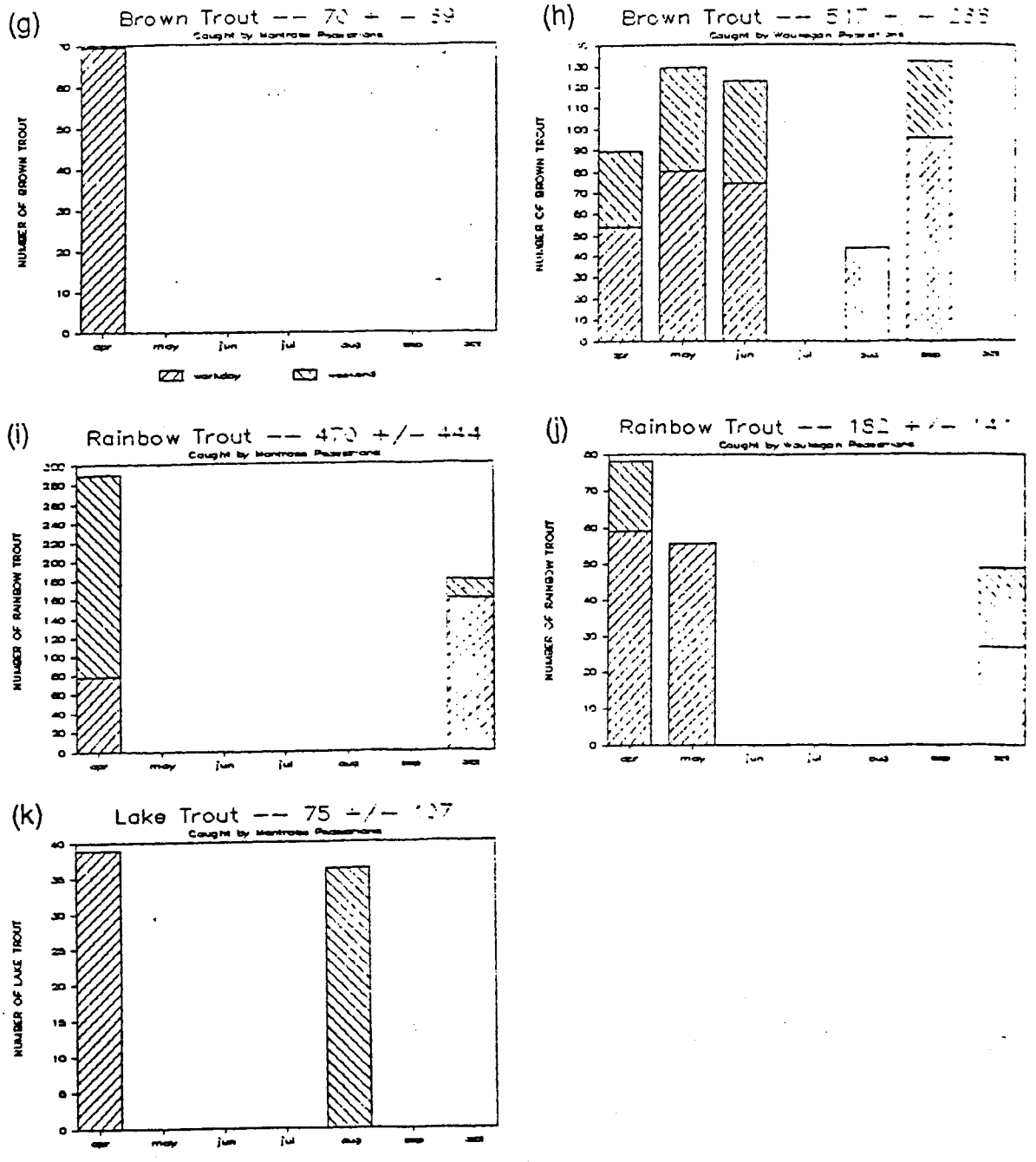

Figure 11 (concluded).

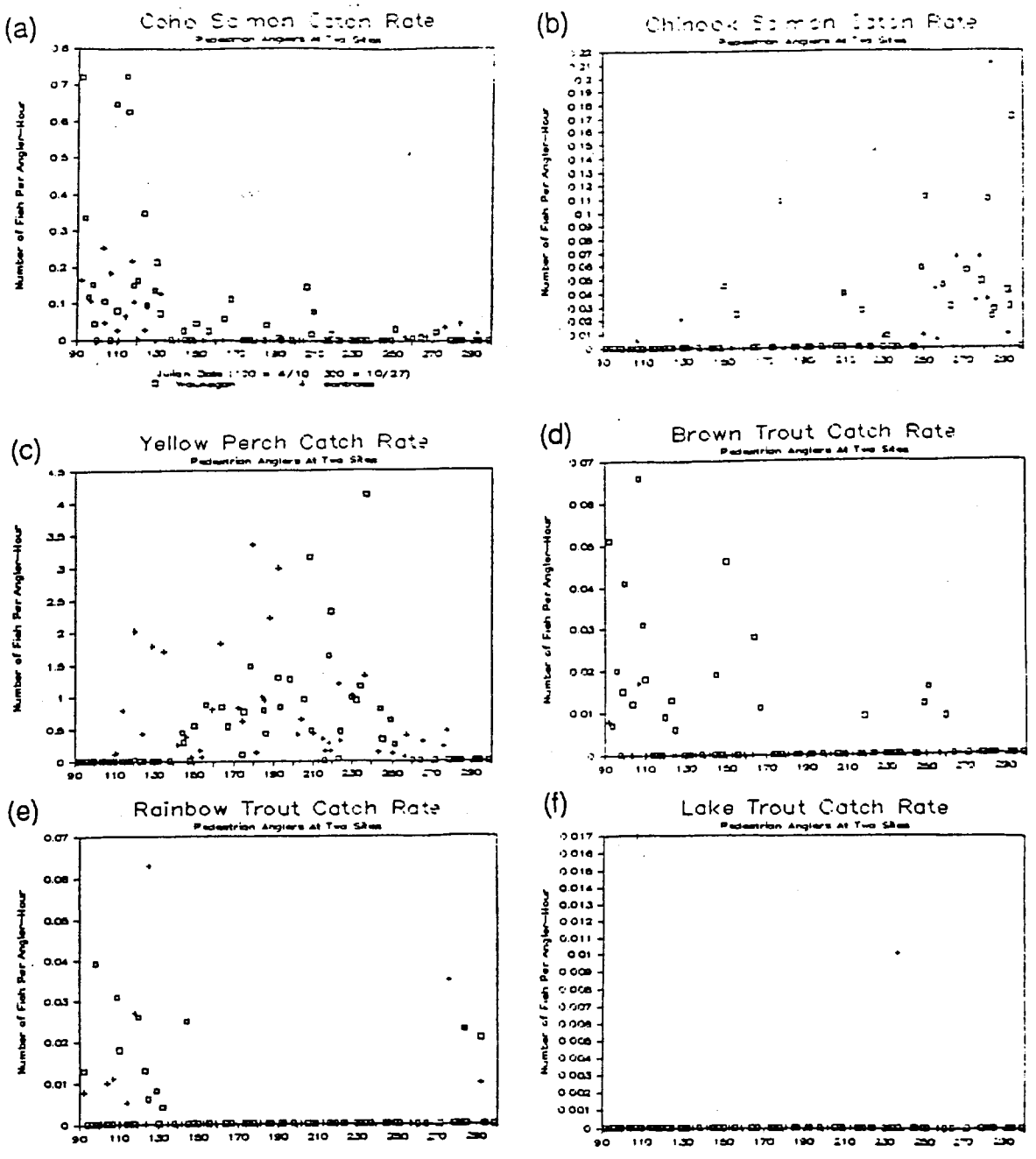

Figure 12. Catch/angler-hour by pedestrians fishing at Waukegan and Montrose Harbors in 1985. Each symbol represents the average catch/angler-hour by all angling parties interviewed on 1 day at both sites. Catch rates are shown for (a) coho and (b) chinook salmon, (c) yellow perch, and (d) brown, (e) rainbow, and (f) lake trout. Julian dates are used; 90 = 1 April and 300 = 27 October.

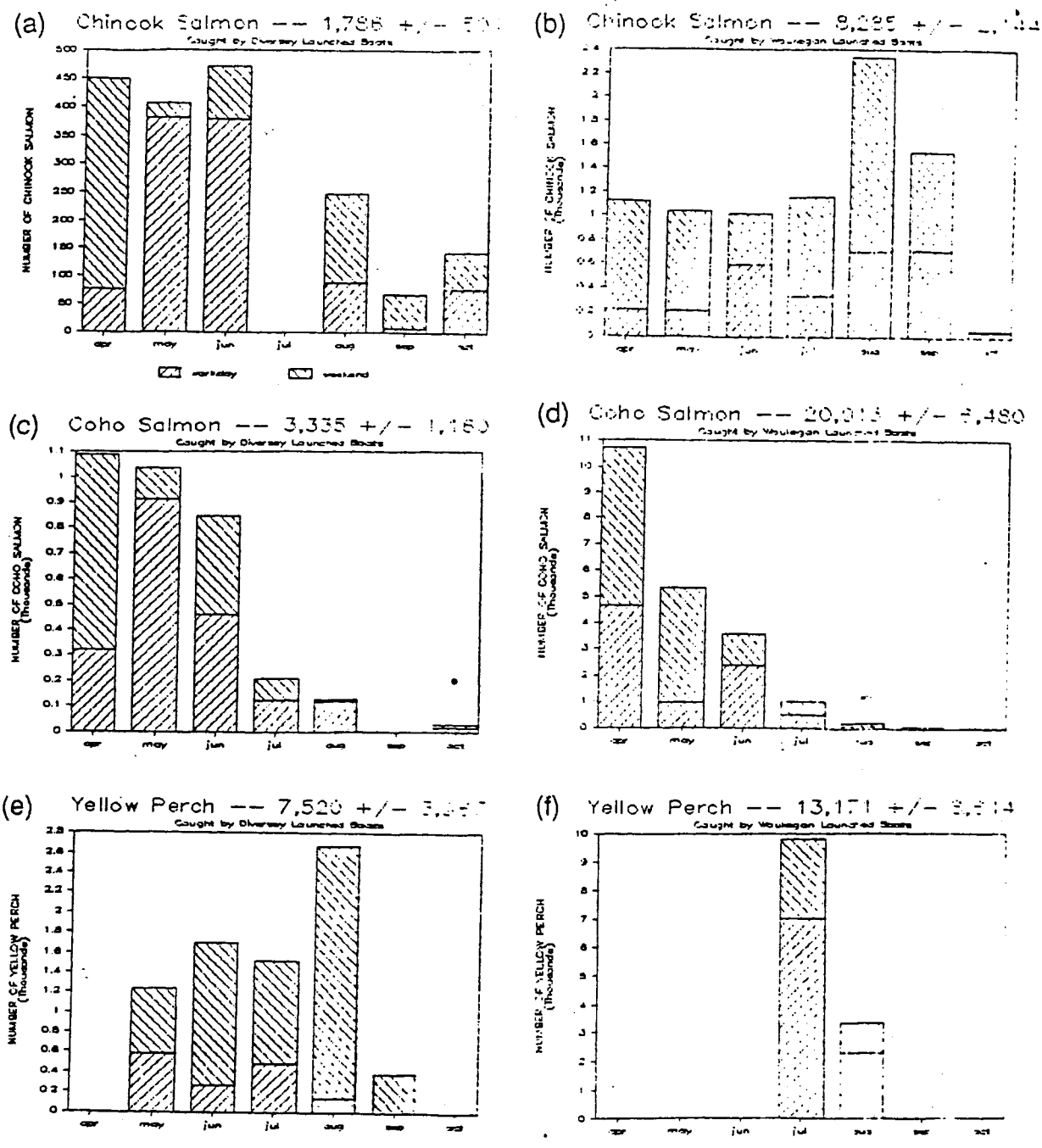

Figure 13. Estimated total catches of six species by anglers launching boats at Diversey and Waukegan Harbors, 1 April-27 October 1985. Totals are divided into approximate monthly intervals (see *Methods* for precise dates) and by type of day. The *Apr* time interval was 6 weeks; all others were 4 weeks long.

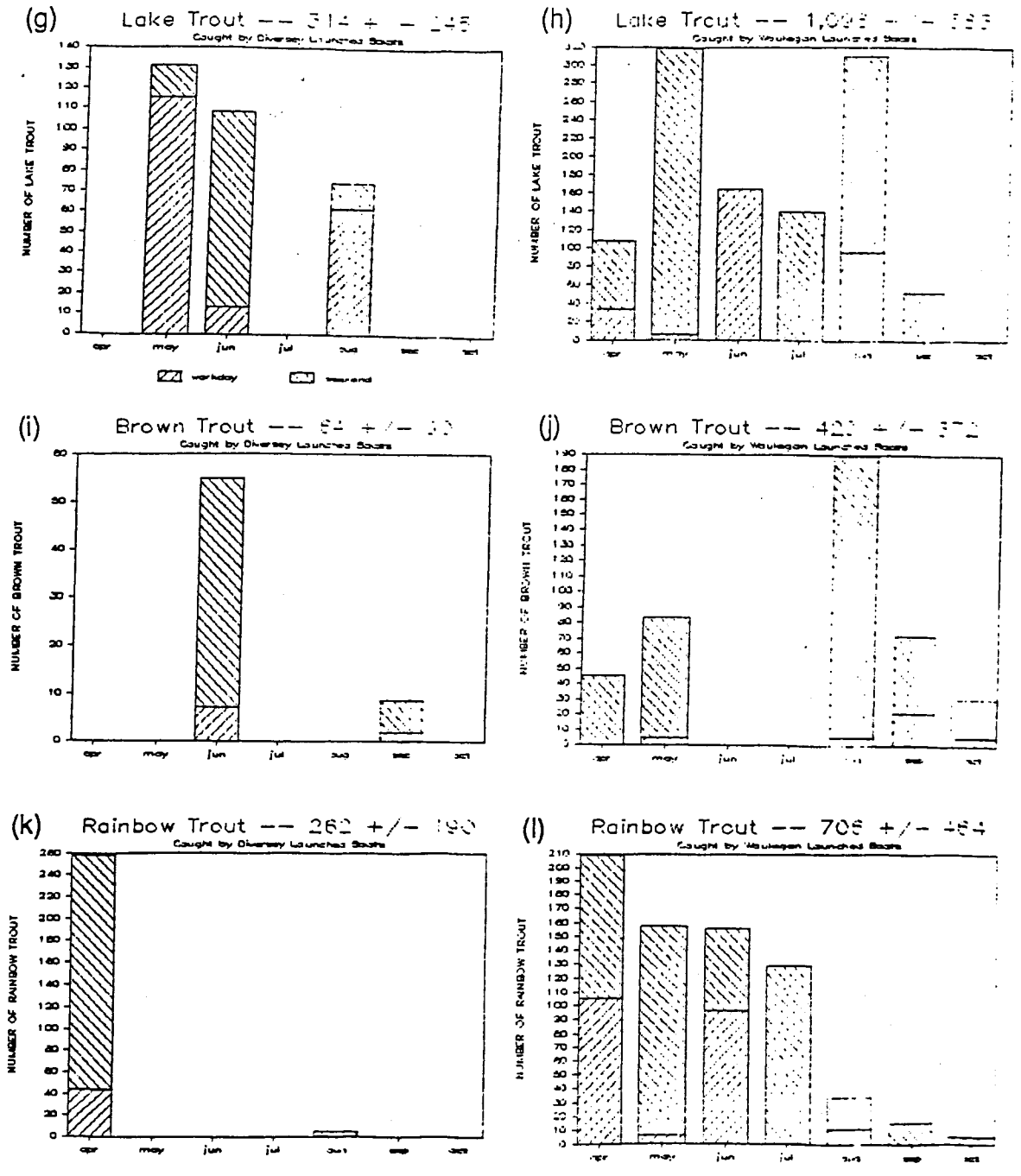

Figure 13 (concluded).

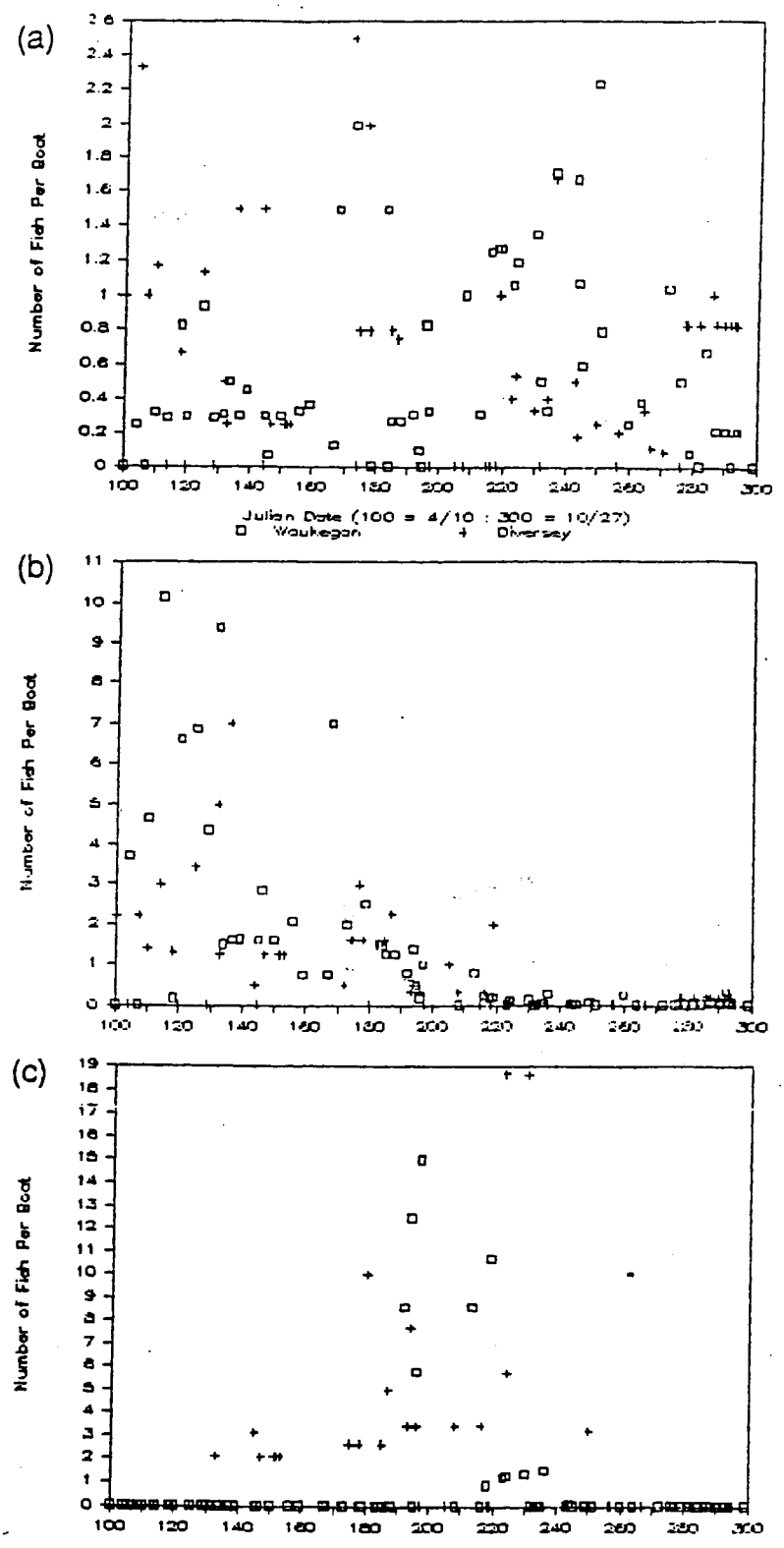

Figure 14. Catch/boat trip by anglers launching boats from Diversey and Waukegan Harbors in 1985. Each symbol represents the average catch/boat trip by all angling parties interviewed on 1 day. Catch rates are shown for (a) chinook and (b) coho salmon, and (c) yellow perch. Julian dates are used; 90 = 1 April and 300 = 27 October.

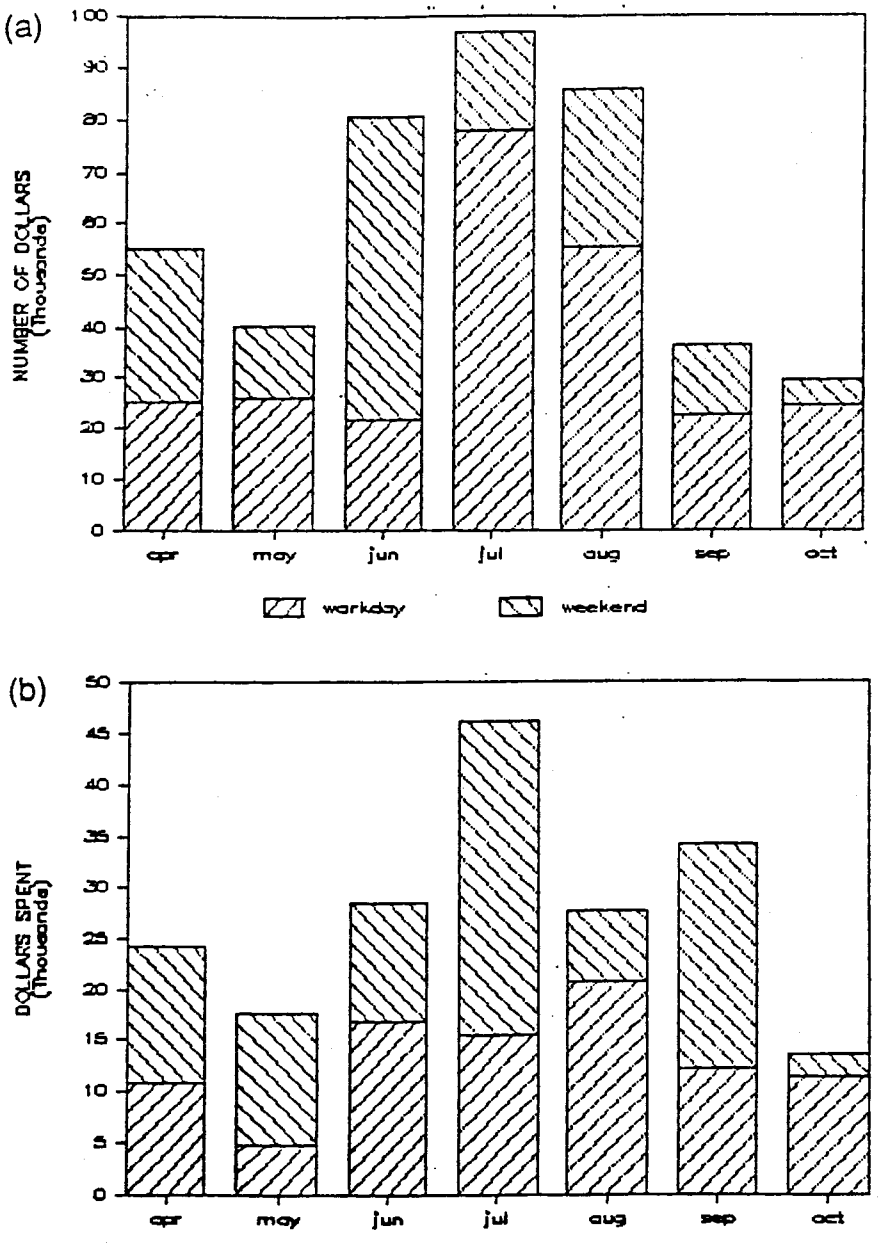

Figure 15. Estimated expenditures by pedestrian anglers visiting Montrose and Waukegan Harbors. Between 1 April and 27 October 1985, pedestrian anglers spent approximately $425,000 for trips to Montrose Harbor and $192,000 for trips to Waukegan Harbor. Totals are divided into approximate monthly intervals (see *Methods* for precise dates) and by type of day. The *Apr* time interval was 6 weeks; all others were 4 weeks long.

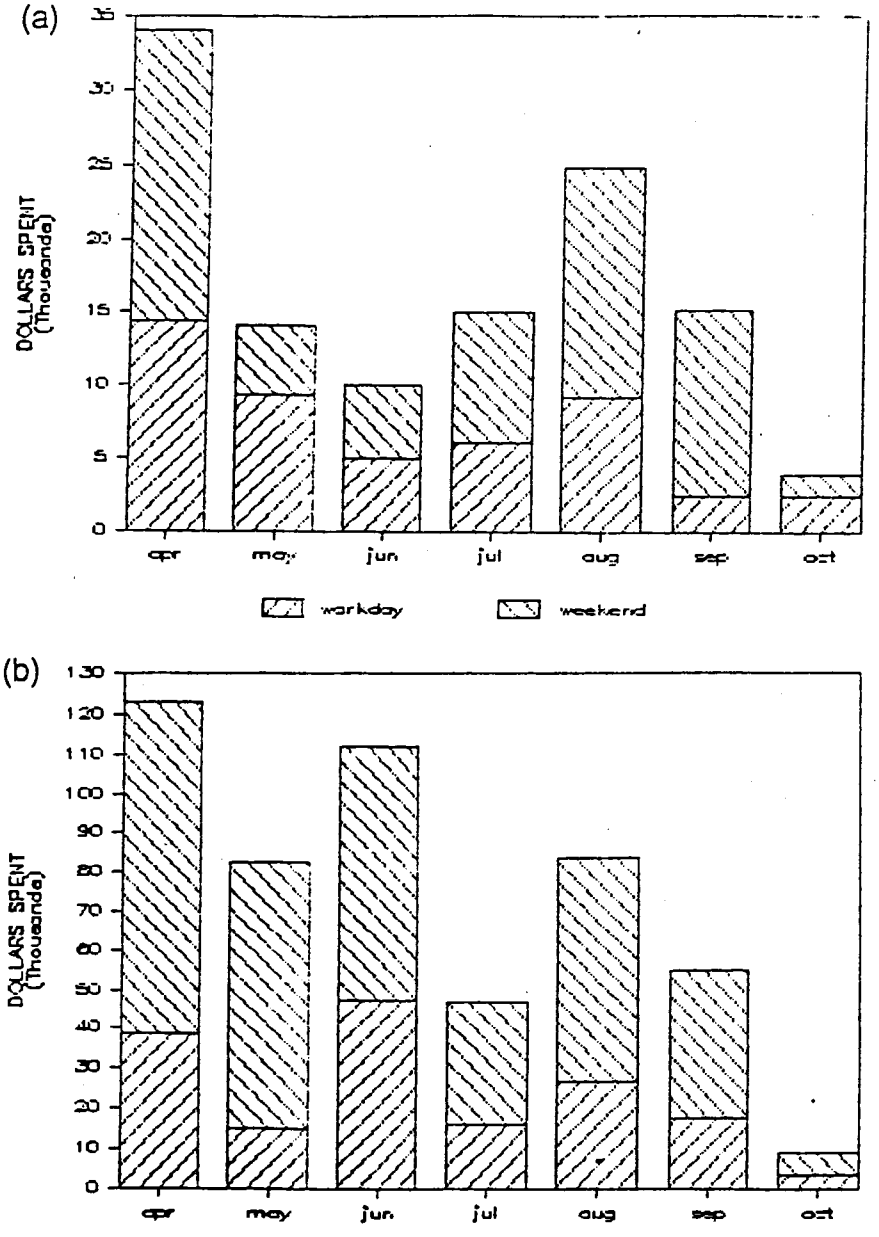

Figure 16. Estimated minor expenditures by fishermen using boats launched from (a) Diversey and (b) Waukegan Harbors in 1985. From 1 April to 27 October 1985, fishermen using Diversey Harbor spent approximately $117,000 and those using Waukegan Harbor $611,000. Totals are divided into approximate monthly intervals (see *Methods* for precise dates) and by type of day. The *Apr* time interval was 6 weeks; all others were 4 weeks long.

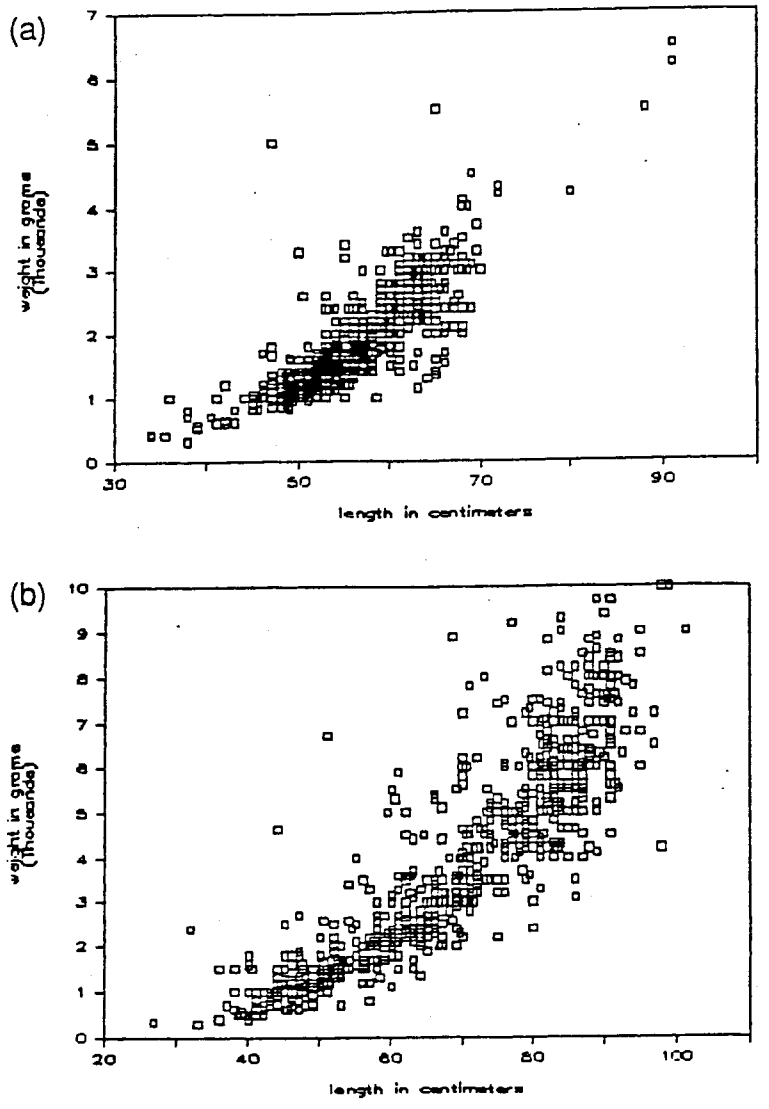

Figure 17. Length and weight distributions of all (a) coho and (b) chinook salmon measured in 1985.

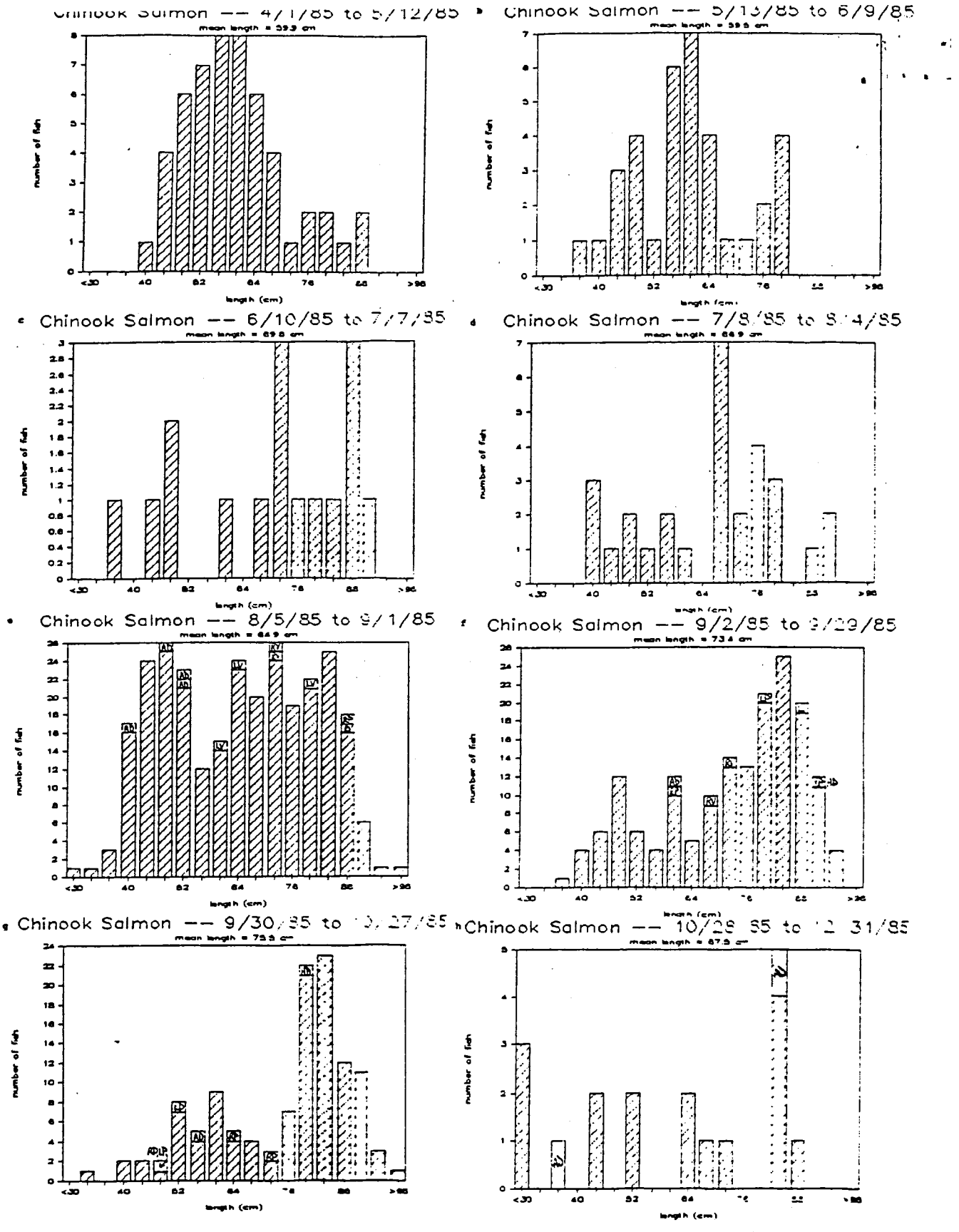

Figure 18. Length-frequency distributions of chinook salmon. Fish with clipped fins are denoted with initials corresponding to the missing fin(s): ad = adipose, lp = left pectoral, rp = right pectoral, lv = left ventral, and rv = right ventral. Most salmon caught between 30 September and 27 October were snagged.

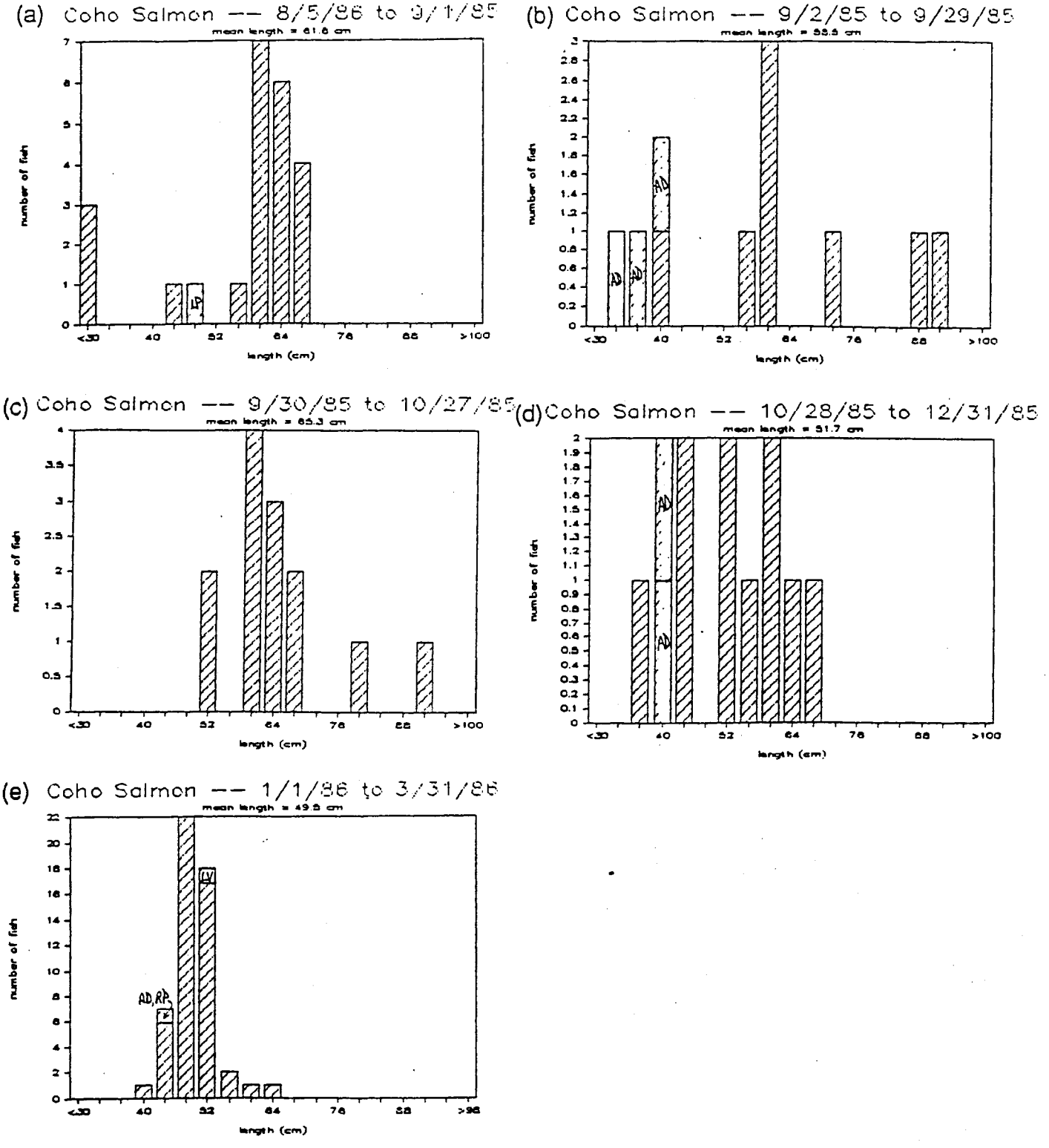

Figure 19. Length-frequency distributions of coho salmon after 5 August 1985. Fish with clipped fins are denoted with initials corresponding to the missing fin(s): ad = adipose, lp = left pectoral, rp = right pectoral, do = dorsal, lv = left ventral, and rv = right ventral. Prior to 5 August, 887 coho salmon were examined; 20 were clipped as follows: 6 ad, 2 lp, 4 rp, 3 do, 2 rv, 1 lp+ad, 1 lp+rp, 1 lv+ad. Most salmon caught between 30 September and 27 October were snagged.

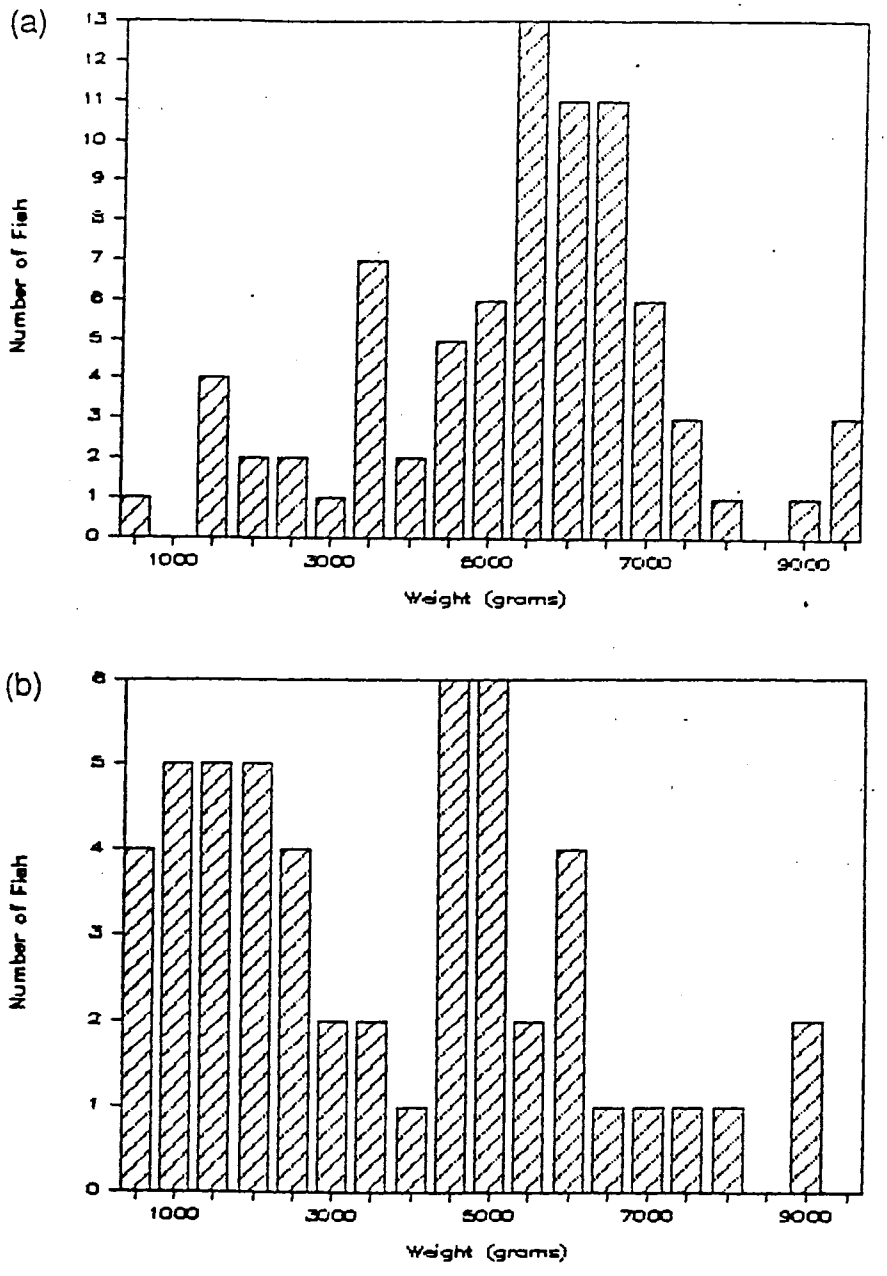

Figure 20. Weight-frequency distributions of chinook salmon (a) snagged and (b) caught by anglers during October 1985.

Appendix 1

CREEL SURVEY FORMS
(instructions to creel clerks)

We record data on two forms, the *Instantaneous Count Form* and the *Interview Form.* Those forms are described here.

NOTE: When these forms are computerized, all blanks are interpreted as zeroes. Therefore, if you do not know the correct value for any space, put a slash through the space.

INSTANTANEOUS COUNTS

The Instantaneous Count form is used to record numbers of anglers and/or trailers at sites indicated on site maps. The form has one line for each site. Occasionally you will conduct comprehensive or other special counts in which you count anglers at locations other than the 27 sites. Those data are also recorded on this form, using the column *Anglers in Vicinity.*

For each site, specific areas are designated for counting pedestrian anglers of different types. You record the numbers of each of six *mutually exclusive* types of pedestrian anglers: harbor, shore, structure, snaggers, smelters, and ice fishermen. The first three types could be called *regular* anglers. As indicated by the maps, an individual site might have areas designated for counting all six types. All *regular* angling areas are considered in counts of smelters. Some forms have spaces "blacked out" opposite sites where particular types of anglers are not routinely counted. **When you visit a site, record data for all types of anglers, unless the space is blacked out.**

When counting anglers, ignore spectators (casual passers-by) but include members of the angling party who are not fishing at the moment, such as family members (spouses and children 5 years and older) who are accompanying the angler.

Sometimes you will count *anglers in the vicinity.* This is the case on selected days when we attempt to obtain counts of **all** anglers on Lake Michigan and whenever snaggers are being counted. These counts are recorded along with a description of the location of the anglers and a specification of the angler *type* (regular, snagger, smelter, or ice fisherman).

Record the total number of trailers of **all** types, but only count empty trailers (those without boats on them).

INTERVIEW FORM

Interviews are obtained in sets. You visit one of the sites and interview a number of angling parties. The interviews are taken from pedestrian anglers or from boaters returning to a launch ramp. When pedestrian anglers are being interviewed, interview either all present or all that can be interviewed in 2 hours. Instantaneous counts of pedestrian anglers are made at the start and finish of the interview set. When all pedestrian fishing parties cannot be interviewed, **interview a representative cross-section.** Thus, if the site includes harbor, shore, and structure areas (see site maps), interview parties from all three areas in proportion to their numbers. Approach all types of people (men, women, Chinese, hispanic, white, polite, surly, *etc.*) without special favor for or against any. To assure impartiality, skip a fixed number of angling parties between interviews, with the number to skip determined so that the entire site is covered during the interview period.

When boaters are interviewed, stay at the ramp for a predetermined time (usually 2 hours) and record data for all returning boats. Sometimes it is not possible to interview all boats. When a boat returning to the ramp is not interviewed, record an ID number, the time (under *interview time*), and either *anglers--no interviews*, *no anglers--power*, or *no anglers--sail.* Counts of trailers are made at the start and finish of the interview period. **It is important that the counts indicate the number of trailers at the exact times when you start and finish you interview set.** Non-anglers, sailors, or non-angling power boat operators are never interviewed.

The Interview Form has four areas for recording data: (1) *site data*, (2) *party record*, (3) *catch record*, and (4) *fish record.*

(1) The *Site Data* area is a condensed version of the Instantaneous Count form. Counts are recorded at the start and finish of each interview set. **Fill in all spaces for the site in question. When conducting boat interviews, record slashes in the pedestrian spaces. When conducting pedestrian interviews, enter a slash when a space is not applicable to the site.**

(2) and (3) The areas designated as *Party Record* and *Catch Record* are filled in during the inteviews. **Remember, the numbers you record should apply to the entire fishing party, not just to the individual to whom you are speaking.** Column headings are:

> ID--interviews (and non-interviewed boats) are sequentially numbered. Assign a number to each pedestrian party interviewed or to each boat that returns to a