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Fishing vessels exploitation

THEORY OF QUEUEING AS SELECTED METHOD FOR OPERATIONS RESEARCH ON SERVICES OF MOTHERSHIPS RENDERED TO FISHING VESSELS AT SEA

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An introduction of new organisation forms in fishing, such as flotilla fishing calls for scientific organisation in service processes of motherships. An attempt have been made to apply one method of operational study based on „theory of congestion and queueing" in order to determine and to bring to minimum the losses resulting from frequent formation of congestions and queuing at motherships.

INTRODUCTION

An operation of fishing vessel is composed of catching, transportation and reloading. The economical effects are mainly determined by fishing operation including fishing days and their output. This tends towards maximalization of fishing days in annual outcome of fishing vessel. As the distance of fishing grounds to unloading port is increasing, the number of fishing days is decreasing and their output may not cover the losses resulting from extended voyages. The restoration of adequate proportion for better economical results may be obtained through introduction of flotilla fishing where majority of transportation duties are handled by transport ships.

In individual fishing of Polish conventional trawlers operating at North-West Atlantic, the number of fishing days for particular voyages is decreasing to 20%. With introduction of flotilla fishing, the participation of fishing days is increasing to ab. 50%. To introduce any new forms in fishing organization, more scientific elaboration of operational processes occuring in predetermined arrangements at sea, are required. The organization of ship services based on obtained experience proved insufficient. Frequent queueings of ships waiting for unloading and supplies from one side, or non-productive laydays of motherships from other side resulted from this. In the presented work, an attempt was made to introduce one of operations research methods based on technological analysis of reloading and supply processes for determination of optimal flotilla operation in servicing of fishing vessels. The work is based on example of Polish flotilla fishing carried out at North-West Atlantic fishing grounds in years 1968 and 1969.

Scientific investigations on flotilla fishing are fragmentary and do not specify the problem in complexity. Majority of such investigations deal with technology of various types of loading A r i s t o v (1968), G o l o v l e v (1966), M a c i e j c z y k (1961), P r i l u d k o (1969), S c h u l t z (1966), S h i m a d a (1951), S o b i s c h (1965), T o ł k o d u b o v (1965). Minor part of investigations relates to output of reloading operations and to general organization principles D u t k i e w i c z and F o r m e l a (1963), G o l d m a n (1967), R u s s e k (1966). Only the works of K i t-k i n (1968), O l k h o w s k i j et.al. (1970), P a z y n i č (1966) and R u d n e v (1967) deserve mentioning as related to subject of adequate operations research on processes of management in fishing ship services, though, broach the subject generally or incomprehensively. No works, however, exist on optimal management of flotilla fishing assisted by motherships type B-67 based on operations research.

MATERIAL

The materials relating to cooperation of mothership "Gryf Pomorski" and fishing vessels on North-West Atlantic fishing grounds in region of New England (position 42°00′N; 067°00′W) had been collected during the expeditions taking place between 28.07.1968-25.11.1968 and 23.08.1969-6.10.1969. The materials comprise data related to fishing ships call to mothership with due consideration to formation of queueings and the results of technological analysis of mooring and reloading processes.

In part relating to moorings, the material partly originates from analysis of radio communication between mothership and fishing vessels, partly from documents of mothership and from direct observations made at anchoring grounds of "Gryf Pomorski".

The time of fishing ships calling for service, their mooring on and off was determined by means of ship′s clock. Collected material formed the base for analysis of fishing ships moorings at mothership. It comprises all notifications made by trawlers for services and laytime of each trawler at "Gryf Pomorski".

METHOD

Evaluation on utility of scientific methods applied for determination of fishing vessels number in operation with mothership

R u s s e k (1966), when determining the organization of flotilla fishing with assistance of mothership B-67, calculated the number of delivery ships,, dividing the daily output capacity of mothership by average daily output of one trawler. In his method, no allowance was given to adverse nature of fishing ships calling to mothership. No consideration was also given to losses due to waiting of mothership for trawlers and due to waiting of trawlers for services. K i t k i n (1968) and R u d n e v (1967), basing on material collected from flotilla fishing, pointed to possibility in application of operations research method in such fishing forms. P a z y n i č (1966), basing on queueing theory, worked out the diagrams applicable for determination of optimal number of delivery ships in cooperation with mothership. However, his method limited the number of possible variants of flotilla fishing to be considered. The actual circumstances are compound and therefore his diagrams may be applicable to certain systems only. An example how to optimate the cooperation of factory trawlers with transport ship, based on the theory of queueing, presented O l k h o v s k i j et al. (1970). As criterium for optimation, they assumed definite number of ships in queue.

Service processes of side trawlers by mothership B-67 were also investigated in this work with application of method based on theory of queueings, which Ł u k a s z e w i c z (1965) included simultaneously for operational research and for theory of stochastic processes. In distinction to previous authors, the minimum of total losses due to laydays is assumed as criterium for optimation.

Theory of queueings as part of operations research in application to investigated processes

By definition "reloading" denoted the process of loads displacement from trawlers into mothership and vice-versa. The term "supply" means the supply of goods required by fishing ships by mothership. "Mooring" is equivalent to term "calling at port". "Service time" means the time counted from moment of mooring on until mooring off. The terms "mooring on and off" mean the adequate processes of fishing vessel fastening on her releasing at sideboard of mothership.

Following denominations are used in this work:

$X(t_1-t_2)$ - number of ships calling for service within time (t_1-t_2)

$F(x)$ - commulative distribution of casual variable X

t_1-t_2 - period of time

t - time unit

k - number of calls

$p_k(t)$ - probability of k calls in time unit t

$p_o(t)$ - probability of 0 calls in time unit t

$p_z(t)$ - probability of at least 1 call in time t

$p(ta)$ - probability for appearance of mean service time ta

$p(tx)$ - probability for appearance of service time $t<x$

$\lambda = \frac{Nt}{Z}$ - rate of flow, mean rate of calls

N - number of calls during observed period of time

Z - number of time units t in period observed

Z_{kt} - number of time units t for k calls

v - time of service

$\bar{v}$ - mean service time

$\mu = \frac{1}{\bar{v}}$ - rate of service

s - number of service posts

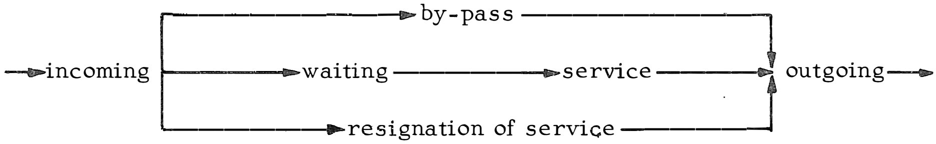
$\overline{m}_s$ mean number of calls waiting (mean length of queue)

$\bar{t}_p$ - mean waiting time in queue

$\tau = 1 - \frac{\lambda}{\mu s}$ - coefficient for idling of service post.

$$\frac{\lambda}{\mu} = \rho$$

General operational diagram for service cycle for which the theory of queueing is applicable (Łukaszewicz, 1965) is presented below:



Time distribution of incoming units is rather of random nature and therefore the incoming process must be considered with probability. Many rules exist for queueing which determine the behaviour of vessels in queueing and sequence for their servicing. The servicing may be performed in single or multichannels interconnected in parallel or in serie. In majority, the model of theory of queueing assumes that the process X(t) complies with three conditions (Łukaszewicz, 1965):

For each "t" $\geqslant 0$ and $a > 0$ the increase $X(t+a) - X(t)$ possesses the distribution of probability dependent on length "a" of time duration (t, t+a) only but, not from situation of this time duration on time-line, and thus:

$$P\{X(t+a) - X(t) = k\} = p_k(a), \qquad k = 0, 1, \ldots \tag{1}$$

This represents the stationary flow of calls.

For any number of seperated time periods

$(a_1, b_1>, /a_2, b_2>, \ldots, /a_n, b_n>$; where $0 \leqslant a_1 < b_1 \leqslant a_2 < b_2 \leqslant \ldots \leqslant a_n < b_n$,

the increaments of process within such time periods

$$X(b_1) - X(a_1),\ X(b_2) - X(a_2), \ldots, X(b_n) - X(a_n)$$

are the casual independent variables (i.r. flow without consequence).

Probability of process increament in exceeding the unity within any small period of time ε tends faster to zero than the length of time period (normal flow).

$$1 - p_o(\varepsilon) - p_1(\varepsilon) = (\varepsilon) \tag{2}$$

It appears from these three conditions that the casual variable X(t+a)-X(t) is of Poisson distribution (Łukaszewicz, 1965):

$$p_k(\varepsilon) = e^{-\lambda} \frac{(\lambda \cdot \varepsilon)^k}{k}, \qquad k = 0,1,\ldots, \tag{3}$$

where: parameter λ is the expected number of vessels arriving to system within time unit.
The assumptions for definition of incoming, service time distribution, number of service channels and regulation of queueing may be noted as follows (Goddard, 1966):

$$X(Y)n \tag{4}$$

where: X - defines incoming process, Y - service times distribution and "n" represents the number of service parallel channels. The process of Poisson on incoming or the exponential time distribution of service is denoted by "M". If no other verbal definitions are applied, the above mentioned formula partains to simplest model with single channel with service conditioned by incoming sequence only, without priority and resignation and with unlimited length of queue.

For further considerations, assumed the model which may be presented by M(M)s. Thus, the actual schedule of calls was compared by statistical fundamentals test of Pearson λ^2 with theoritical schedule calculated according to Poisson formula. For analysis of calls, assumed the material originated from period within which daily output for one side-trawler exceeded 10 tons. Thus, obtained the compliance with condition of calls flow stability, eliminating the variations in mean rate of calls appearing during mothership stay at fishing grounds. Similiar example on application of queueing theory was noted for examination of work of telephone exchange by Rozenberg and Prochorov (1965).

The selected period of time was divided into one-hour timelengths (t = 1 hour). Thus obtained considerable number of such units permitted for correct performance of test χ^2 (Greń, 1968). For material designated for analysis verified that ratio $\frac{\lambda}{\mu \cdot s} < 1$, what conditions the attainment of statistical ballance (Goddard, 1966), for system for which the probalities $p_o, p_1, \ldots, p_n(t)$ comply to equation:

$$\lambda p_o = \mu p_1 \tag{5}$$

$$(\lambda + n\mu)p_n = \lambda p_{n-1} + (n+1)\mu p_{n+1} \qquad \text{for} \quad 1 \leqslant n < c \tag{6}$$

$$(\lambda + c\mu)p_n = \lambda p_{n-1} + \mu c p_{n+1} \qquad \text{for} \quad n \geqslant c \tag{7}$$

where: c = s.
G o d d a r d (1966) supplements the following solution for equations of (5), (6) and (7):

$$p_n = \frac{p_o \rho^n}{n!} \qquad \text{for } 1 \leqslant n < c \tag{8}$$

$$p_n = \frac{p_o \rho^n}{c!\, c^{n-c}} \qquad \text{for } n \geqslant c \tag{9}$$

Value p_o obtained from condition $\sum_{n=0}^{\infty} p_n = 1$:

$$p_o = \frac{1}{\dfrac{\left(\frac{\lambda}{\mu}\right)^s}{s!\left(1 - \frac{\lambda}{\mu s}\right)} + \sum_{n=0}^{s-1} \dfrac{\left(\frac{\lambda}{\mu}\right)^n}{n!}} \tag{10}$$

Knowing p_o and p_n, we obtain the following expression for $\overline{m}_s$ (G o d d a r d, 1966):

$$\overline{m}_s = \frac{p_o \left(\frac{\lambda}{\mu}\right)^s \frac{\lambda}{\mu s}}{s!\left(1 - \frac{\lambda}{s\mu}\right)^2} \tag{11}$$

Substituting p_o for formula (11), the values obtained from equation (10) and divided by λ we obtain:

$$\overline{t}_p = \frac{\overline{m}_s}{\lambda} = \frac{\frac{1}{s!}\left(\frac{\lambda}{\mu}\right)^s e^{-\frac{\lambda}{\mu}}}{\frac{1}{s!}\left(\frac{\lambda}{\mu}\right)^s e^{-\frac{\lambda}{\mu}} + \left(1 - \frac{\lambda}{\mu s}\right)\sum_{n=0}^{s-1} \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n e^{-\frac{\lambda}{\mu}}} \cdot \frac{1}{\mu s - \lambda} \tag{12}$$

where: expression $e^{-\frac{\lambda}{\mu}}$ was introduced owing to its application in tables (M a d z i a r, 1968).
Idling coefficient of service post calculated from formula:

$$\tau = 1 - \frac{\lambda}{\mu s} \tag{13}$$

Optimal number of delivery ships in cooperation with mothership, calculated according to minimizing criterion total for losses of fishing fleet and of mothership due to demurrages:

$$K_o = K_b + K_f = \text{min.} \tag{14}$$

where: K_o - total losses on system, K_b - losses of mothership, K_f - losses of trawlers. The values of K_b and K_f calculated from the following formulas:

$$K_b = \tau_m \cdot s \cdot k_p \qquad (15)$$

$$K_f = \lambda_m \cdot \bar{t}_p \cdot k_s$$

where: m - denotes number of vessels serviced by mothership, k_p - work value of one service stand during one hour of time "t", k_s - work value of one trawler during one hour.

RESULTS

In fishing fleet participated the side-board trawlers B-10, B-14 and B-20 and stern-trawlers type B-23 and B-18 (tab.1). The side-board trawlers were delivering to mothership fresh fish for freezing, salted fish and the catches for fish meal processing. The trawlers B-20 were additionally supplying part of frozen fish. Stern-trawlers were supplying the frozen product and fish meal.

For moment of calling assumed the time when fishing ship arrived to anchoring grounds of mothership. In majority of cases, this moment was coinciding with beginning of mooring. The differences between time of arrival to anchoring grounds and beginning of mooring, occured under such circumstances when mothership could not start immediate servicing. This caused the formation of queue of trawlers waiting for unloading or supplies. According to previously assumed principle for selection of data for analysis of calls flow, selected the month September 1968. The investigated period was divided into one hour lengths and thenafter, number of calls within each of them was noted. The results are presented in Table 2. Thenafter, distribution arrangement was made (G r e ń, 1968) and mean number of calls calculated:

$$\lambda = \frac{\sum(k \cdot Z_k)}{Z} = \frac{177}{720} = 0.246$$

where: $\sum(k \cdot Z_k)$ is number of calls, and

Z - number of one hour lengths in month.

Theoritical dispersion of calls was calculated on assumption that it possesses the characteristics of Poisson arrangement. Both dispersions were verified by test χ^2, which proved that no grounds exist for rejection of hypothesis according, to which the distribution of fishing vessel calls for services complies with Poisson arrangement (Tab.2). The test was performed on level of substantial material $\alpha = 0.05$.

$$\chi^2 = \sum \frac{\left[Z_k - Zp_k(t)\right]^2}{Zp_k(t)} = 4.463$$

Value χ^2 0.05; 2 amounts to 5.991 (G o l d s t e i n, 1964), thus $\chi^2 < \chi^2$ 0.05; 2.

Table 1

General characteristics of fishing fleet

Type of ship	Length (m)	Breadth (m)	Draft (m)	Speed (knots)	Crew (pers.)	Hold capac. (m^3)	Main engine power KMe	Operat. range (days)
B-10/14	59	9	4.4	11-12	30	380	1200/800	23/28
B-20	61.5	9.8	4.4	12.8	31/33	598	1375	45
B-18	87.25	14.1	5.4	13.8	74-82	1680	2250	75
B-23	69.2	11.0	5.05	14.0	37-42	610	1620	50
Mother-ship B-67	164	21.3	7.8	15.5	256	10130	6550	80

Table 2

Calculation of value χ^2 for actual distribution of fishing vessels calls for services

k	Z_k	$p_k(t)$	$Zp_k(t)$	$[Z_k - Zp_k(t)]^2$	$\frac{[Z_k - Zp_k(t)]^2}{Zp_k(t)}$
0	572	0,779	561	121	0.216
1	124	0.194	139	225	1.619
2	21	0.024	17	16	0.941
3	2	0.0021	1.44		
4	0 3	0.00012	0	2.43	1.687
5	1	-	0		

Mean service time of ships in cooperation with mothership "Gryf Pomorski" amounted to 403 minutes. Mean service times for particular types of delivery ships in relation to purpose of mooring at mothership, are given in Table 3.

Table 3

Mean service time of fishing ships in relation to purpose of mooring

Main mooring purpose	Service time (min.)				
	B-10	B-14	B-20	B-23	B-18
Reloading of barrels	745	701	659	-	-
Delivery of fresh fish	148	153	160	-	-
Unloading of frozen fish	-	-	1320	1673	2041
Supplies	398	362	286	-	-
Repairs	703	470	760	878	-
Others[x)]	38	35	24	-	-

[x)] most frequently delivery of sick case.

Basing on the results presented above, an attempt was made to form the simplified mathematical model of fishing ships services by mothership B-67. Such model would show the possibility to minimize the losses caused by demurrage of fishing fleet and of mothership. Four main assumptions in compliance to requirements of model formations were considered:

1. Fishing fleet comprises the motor side-board trawlers type B-20; consideration was given to their good behaviour on sea, their equipment with freezing arrangements which makes their predisposition for cooperation with mothership B-67.
2. Mean daily output of trawlers based on catches amounts to 16 tons, with majority of herring.
3. Reloading is effected by alongside method.
4. Mothership is servicing two trawlers simultaneously. (Number of service posts $s = 2$).

At the assumed mean fishing output of 16 t daily and daily freezing capacity amounting practically about 6 tons for trawler B-20, complete filling of holds with salted fish is attained after 10 days (1000 barrels), while the holds with frozen fish are within this time filled-up to about 45%. Owing to such reserve, the trawlers may continue limited catches to 6 tons/day directly after determination of queue for unloading. According to indices obtained is period of investigations on output of reloading works, unloading of 1000 barrels with salted fish and acceptance of adequate quantity of empty barrels with salt lasts in average 8.5 hour; unloading of 60 tons of frozen fish and acceptance of cartoons averages to about 7 hours; acceptance of food stuff and of fishing gear averages to about 2 hours; opening and closing of hatchcovers and mooring operations require 1.5 hr. Average time of one trawler at mothership amounts thus to 19 hrs. Assuming, that voyaging from fishing grounds to mothership and back of fishing vessel amounts in average to 5 hrs, the mean value of service time for one call amounts to 24 hrs. Rate of service equals to:

$$\mu = \frac{1}{19+5} = 0.0417$$

Operation cycle of one trawler, according to assumptions accepted, comprises: fishing (240 hrs) + voyage to mothership (2.5 hrs) + layday at mothership (19 hrs) + voyaging to fishing grounds (2.5 hrs). In all, it lasts for 264 hrs. If the mothership would service only one fishing ship, mean flow of calls would amount to:

$$\lambda = \frac{Nt}{Z} = \frac{1}{264} = 0.0038$$

The values λ for larger number of trawlers operating with mothership "m" are given in Table 4.

Assuming that distribution of calls in time complies to Poisson arrangement, we find the mean waiting time for service $\bar{t}_p$ and mean length of queue. The values $\bar{t}_p$ in relation to "m", calculated according to formula (12) are given in Table 5. In Table 5 are also presented the values of mean length of queue calculated according to dependence:

$$\bar{m}_s = \lambda_m \cdot \bar{t}_p$$

Table 4

Mean flow of calls λ at various numbers of fishing vessels "m" serviced by mothership

m	λ	m	λ
1	0.0038	11	0.0417
2	0.0076	12	0.0455
3	0.0114	13	0.0492
4	0.0152	14	0.0530
5	0.0189	15	0.0568
6	0.0227	16	0.0606
7	0.0265	17	0.0644
8	0.0303	18	0.0682
9	0.0341	19	0.0720
10	0.0379	20	0.0758

Table 5

Mean waiting time for service $\bar{t}p$ and mean length of queue $\bar{m}_s$ in relation to number of trawlers operating with mothership "m"

m	$\bar{t}_p$	$\bar{m}_s$	m	$\bar{t}_p$	$\bar{m}_s$
1	-	-	11	7.91	0.33
2	0.198	0.0015	12	10.29	0.47
3	0.458	0.0052	13	12.86	0.63
4	0.821	0.012	14	16.12	0.85
5	1.287	0.024	15	20.68	1.18
6	1.911	0.043	16	27.19	1.65
7	2.64	0.07	17	35.26	2.27
8	3.76	0.11	18	48.68	3.31
9	4.81	0.17	19	70.17	5.05
10	6.15	0.23	20	114.47	8.70

The coefficient for idling of servicing post τ in relation to "m" calculated of formula (13). The results are presented in Table 6.

Table 6

Ratio of coefficient value for idling for servicing post to number of fishing vessels serviced by mothership "m"

m	τ	m	τ
1	0.954	11	0.500
2	0.909	12	0.454
3	0.863	13	0.410
4	0.818	14	0.365
5	0.773	15	0.319
6	0.728	16	0.273
7	0.682	17	0.228
8	0.637	18	0.182
9	0.591	19	0.137
10	0.546	20	0.091

For selection of optimal number of delivery ships applied the formula (14). The operation value of one servicing stand for trawler B-20 comprises the following tariffs:

1. Tariff for reloading. According to rates prevailing for investigated period (T a r y f a, 1960) for reloading
   of frozen fish 60 t x 69 Zł/t = 4140 Zł.; for reloading
   of salted fish 80 t x 67 Zł/t = 5360 Zł.; for reloading
   of empty barrels 15 t x 267 Zł/t = 4005 Zł. and for reloading
   of salt in barrels 25 t x 85 Zł/t = 2125 Zł. Totally the tariffs for reloading amount to 15.630 Zł.
2. Dues for repair and medical aid services are estimated to average about 1.000 Zł.
3. Freight: At rate 2.000 Zł. per ton (R u s s e k, 1966) it amounts to 140 t x 2000 Zł/t = 280000 Zł.

Dividing the above totals of dues by 19, we obtain the average operation value of servicing post during one hour

$$k_p = 15.000 \text{ Zł.}$$

The cost of demurrage of one trawler at anchoring grounds during one hour, at mean price of 1 ton of fish 10.000 Zł. (F r ą t c z a k, 1969) amounts to:

$$k_s = \frac{16 \cdot 10.000}{24} = 6.670 \text{ Zł.}$$

Total losses for mothership and trawlers calculated out of formulas (14), (15) and (16). The results are presented on diagram 1. The bottom of presented curve corresponds to optimal number of trawlers B-20 operating with mothership and amounts "m" - 13 trawlers.

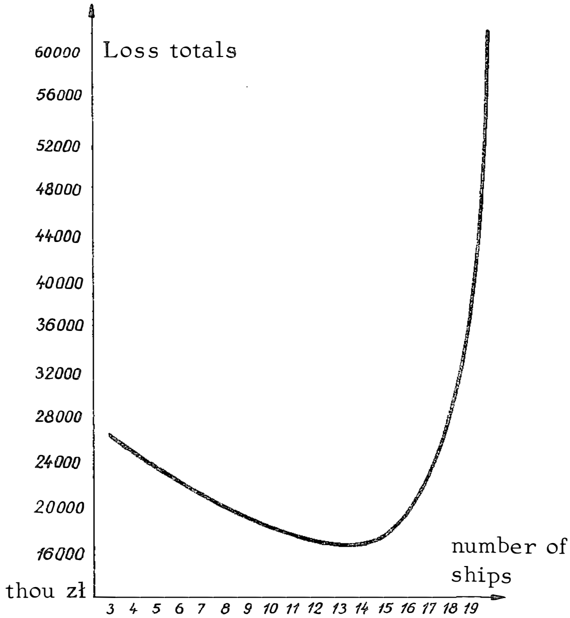


Fig.1. Ratio of total losses of trawler and mothership related to number of trawlers operating with mothership

DISCUSSION

From previously presented works relating to application of queueing theory to optimate flotilla fishing, only the work of Pazynič (1966) corresponds to assumptions accepted in this model. One of his diagrams corresponds to values: $s = 2$ and $\frac{k_p}{k_s} = 2$. In our model, the ratio $\frac{k_p}{k_s}$ amounts approximately 2.25 and thus is very near to value assumed by Pazynič (1966). Thus, the comparison of his result to ours is possible. The value "m" taken from his diagram, for such assumptions amounts to about 12.5.

CONCLUSION

1. Calls of fishing vessels for servicing to mothership B-67, during high outputs at Georges Bank fishing grounds, correspond in time distribution to arrangement of Poisson.

2. Such arrangement permits for application of theory of queueing as one of methods for operations research to minimize the losses resulting from demurrages of fishing ships in queue at mothership and of non-productive demurrages of mothership.

3. Complex solution for management of flotilla fishing may be obtained solely by application of electronic calculation technics, owing to large quantity and more complicated nature of production - service parameters than were assumed in simplified model.

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PRÓBA ZASTOSOWANIA TEORII KOLEJEK DO PROCESÓW OBSŁUGI STATKÓW ŁOWCZYCH NA MORZU PRZEZ STATEK BAZĘ

S t r e s z c z e n i e

Wprowadzenie połowów zespołowych w rybołówstwie dalekomorskim wywołało w praktyce szereg niedomagań o charakterze organizacyjnym. Do najczęściej występujących należały tworzące się kolejki statków łowczych oczekujących na rozładunek oraz nieprodukcyjne przestoje statków baz.

Dla rozwiązania tych trudności podjęto próbę zastosowania badań operacyjnych w zarządzaniu, wykorzystując do tego krajowe połowy zespołowe dokonywane w latach 1968 i 1969 na łowiskach Płn.-Zach. Atlantyku, w oparciu o statek bazę B-67. Na podstawie przeprowadzonych analiz stwierdzono, że zgłoszenia statków łowczych do obsługi przez bazę w okresie wysokich wydajności połowowych noszą charakter rozkładu czasowego Poissona. Układ ten pozwolił na zastosowanie teorii kolejek jako jednej z metod badań operacyjnych do uzyskania minimalnych strat wynikających z przestojów statków łowczych w kolejce przy bazie oraz nieprodukcyjnych przestojów samej bazy.

Dalsze usprawnienia w kierowaniu połowami zespołowymi można osiągnąć dopiero przez zastosowanie elektronicznej techniki obliczeniowej ze względu na znaczną liczbę i skomplikowany charakter parametrów produkcyjno-usłu-

gowych, trudnych do rozwiązania w przyjętym modelu uproszczonym.

ПРИМЕНЕНИЕ ТЕОРИИ МАССОВОГО ОБСЛУЖИВАНИЯ ДЛЯ РАБОТЫ ПЛАВБАЗ С ПРОМЫСЛОВЫМИ СУДАМИ В МОРЕ

Р е з ю м е

Внедрение экспедиционной формы промысла привело в практике к ряду затруднений имеющих организационный характер. Среди них очень часто выступали очереди промысловых судов ожидающих на обработку у причалов плавбазы и случаи непродуктивных простоев плавбазы. Для решения этих затруднений установили применять методы операционных исследований используя данные из польского экспелиционного промысла в северозападной Атлантике в 1968-69 г. с участием плавбаз типа Б-67.

На основе проведенного статистического анализа решили что во время высоких среднесуточных уловов распределение заявлений промысловых судов к обработке у плавбазы имеет характер распределения Пуассона. Это способствует применению теории массового обслуживания для получения наименьших потерь следующих из простоя промысловых судов в очереди или из непродуктивного простоя плавбазы в случае отсуствия промысловых судов до обработания.

Дальнейшие развитие управления экспедиционным промыслом можно получить лишь только при помощи применения электронической обработки данных на ЭВМ.

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