

DAILY DYNAMICS OF THE ELEMENTS OF MULE DUCKS BEHAVIOR AT A DIFFERENT AGE, BRED IN INTEGRATED FISH PONDS UNDER DIFFERENT NUTRIENT REGIMES. I. AT FEEDING WITH BALANCED COMMERCIAL MIXTURE.

ДНЕВНА ДИНАМИКА НА ЕЛЕМЕНТИТЕ НА ПОВЕДЕНИЕТО НА МЮЛАРИ НА РАЗЛИЧНА ВЪЗРАСТ, ОТГЛЕЖДАНИ В ИНТЕГРИРАНИ РИБОВЪДНИ БАСЕЙНИ ПРИ РАЗЛИЧНИ ХРАНИТЕЛНИ РЕЖИМИ.  
I. ПРИ ХРАНЕНЕ С ПЪЛНОДАЖБЕНИ ЗАВОДСКИ СМЕСКИ.

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**ABSTRACT**

An investigation upon the daily dynamics of the separate elements of mule ducks behavior has been carried out at the Institute of Fisheries and Aquaculture Plovdiv, Bulgaria, applying the schedule of feeding with full-ration factory-made mixtures, at conditions of integrated fish-ducks technology. Ducks used to enter the water for a short time, and the time for swimming reported has been 9.63 min.h<sup>-1</sup> while the time spent at rest in the water has not surpassed 2.5 min.h<sup>-1</sup>. Age differences concerning behavior have been observed. With the advance of the fattening period, in general, the motion activity has decreased, ducks have reacted weaker to forage supply, and the forages have been consumed more actively during the morning hours. The tested technology has ensured good rearing conditions of mule ducks, however, the influence of ducks upon fishpond ecosystem was minimal.

Keywords: behavior; fish-cum-duck farming; nutrition; day dynamics; technology

**АБСТРАКТ**

В Института по рибарство и аквакултури-Пловдив, България, беше проведено проучване на дневната динамика на отделните елементи на поведението на мюлари, при хранене с пълнодажбени заводски смеси в условията на интегрирана технология риба-патици. Патетата влизат във водата за кратко време, като отчетено максимално време за плуване е 9.63 min.h<sup>-1</sup>, а времето, прекарано в почивка във водата не е надвишило 2.5 min.h<sup>-1</sup>. Налице са възрастови различия по отношение на поведението. С напредване на угоителния период като цяло двигателната активност намалява, патетата по-слабо реагират на залагането на фуража, като по-активно фуражите се консумират в сутрешните часове. Изпитана технология осигурява добри условия за отглеждане за мюларите, но влиянието на патетата върху екосистемата на рибовъдния басейн е минимално.

Ключови думи: поведение, интеграция риба-патици; хранене; дневна динамика; технология

## DETAILED ABSTRACT

Експериментът беше проведен в Института по рибарство и аквакултури – Пловдив. За интегрирано отглеждане мюларите бяха поставени в ограден шаранов угоителен басейн с гъстота 340 бр.ха<sup>-1</sup>. На дигата на басейна беше изграден лек навес за подслон, като патетата денонощно имаха неограничен достъп до водната площ. Хранилките на рибите бяха оградени с мрежа, за да се ограничи достъпът на патиците. През експерименталния период на всяко пате бяха осигурени средно по 0.200 kg дневно балансирана търговска смеска със съдържание 18.2% суров протеин (СП); 12.2 MJ.kg<sup>-1</sup> обменна енергия; 3.8% сурови влакнини (СВ); 0.868% Лизин; 0.657% метионин+цистин; 2.7% сурови мазнини (СМ); 0.954% Са; 0.679% Р. Храната беше залагана двукратно в денонощието (сутрин и вечер), на дигата на басейна. За проучването на поведението и възрастовата динамика на етологичните елементи бяха проведени пет 10-часови наблюдения (от 8 до 18 ч) от края на юли до края на август. Наблюденията се провеждаха с интервали от 7 дни в периода от 28- до 56- дневна възраст. За регистрация на поведението беше използван групов хронометраж с интервал от 15 min. Поведението на патетата е описано чрез отделни видове активности, разделени на групи – движение на суша, покой на сушата (стоят, лежат), хранене, активно (плуват) и пасивно (лежат) поведение във водата. Установени са възрастови разлики, по отношение на реагирането на залагането на храната на дигата и хранителното поведение като цяло. С напредване на възрастта патетата по-слабо реагира на поставянето на храна, като най-активното хранително поведение се проявява в сутрешните часове. По-значителна двигателна активност е регистрирана на по-малката възраст, като с напредването на угоителния период тя е намалявала. Като цяло, хранене на мюларите с пълнодажбени заводски смеси не стимулира активното търсене на храна в басейна. Патетата влизат във водата за кратко време, като отчетено максимално време за плуване е 9.63 min.h<sup>-1</sup>, а времето, прекарано в почивка във водата не е надвишило 2.5 min.h<sup>-1</sup>.

## INTRODUCTION

The integration of aquaculture and the different sub-branches of agriculture have a significant contribution for increasing production stability [4]. Different breeds of ducks have been utilized for breeding in fish-ponds. The mule ducks are hybrids between Pekin ducks and Muscovy ducks, which are considerably different from each other [6] in biological sense. Pekin ducks are

typical representatives of water-swimming birds, while the Muscovy ducks prefer more to stay on dry land than to stay in the water [1]. Hoffman [5] has noted that mule ducks are similar to Muscovy ducks as regards their behavior, with the exception that they move slower and that they stay in the water for a longer time. Mule ducks find wider and wider application in integrated fish-cum-duck farms. At the same time the information for their behavior in fish-ponds has been rather scarce. In the integrated production systems, ducks have been an important factor, influencing upon the ecosystem of the fish-pond by means of the functions which they execute in the water. In this sense, mule ducks behavior at conditions of integration and different approaches of nutrition is very interesting.

In this study our aim has been to investigate the daily dynamics of the separate elements of mule ducks behavior, when fed on full-ration factory-made mixtures.

## MATERIALS AND METHODS

The experiment has been carried out at the Institute of Fisheries and Aquacultures – Plovdiv. As far as integrated breeding is concerned, mule ducks have been placed in a net enclosure carp-fattening pond at a density of 340 p-ces.ha<sup>-1</sup>. A light shelter has been built on the dike of the fish-pond. The mule ducks have had an unlimited access to the aqua-area all day and night long. The fish feeding-troughs have been net-enclosed in order to limit the access of ducks. During the experimental period, each duck has received 0.200 kg at an average balanced commercial mixture daily, with the following content: 18.2% crude protein (CP); 12.2% MJ.kg<sup>-1</sup> exchange energy; 3.8% crude fiber (CF); 0.868% lysine; 0.657% of methionine + cistein; 2.7% crude fat (CF); 0.954% Ca; 0.679% P. The feed has been supplied twice day and night (in the morning and in the evening) on the embankment of the fish-pond. For the purpose of investigating the behavior and age dynamics of ethological elements five 10-hours' observations (from 8 a.m. till 6 p.m.) have been carried out from the end of July till the end of August. The observations have been carried out at 7 days' intervals within the period 28-days' to 56-days' age. In order to register the behavior group timing with 15 min interval has been used. Ducks behavior has been described by means of separate types of activities divided into groups – motion on dry land, at rest on dry land (standing, lying), nutrition, active (swimming) and passive (lying) behavior in the water [3].

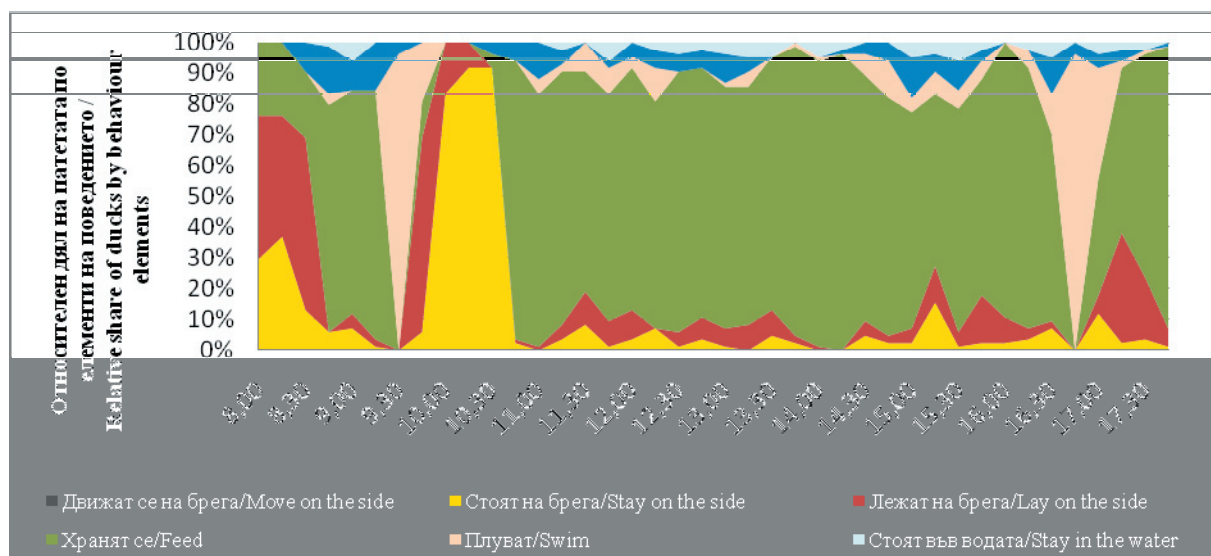
## RESULTS AND DISCUSSION

After they have been transferred into the fish-pond, the

mule ducks have adapted quickly to the new conditions of breeding. Our observations have shown that the mule ducks have entered the water right away during the first day. Table 1 describes the absolute and the relative shares of behavioral elements per each hour of the monitoring, and Fig. 1-5 – the ethograms, demonstrating behavioral picture changes after every new registration during the separate age periods.

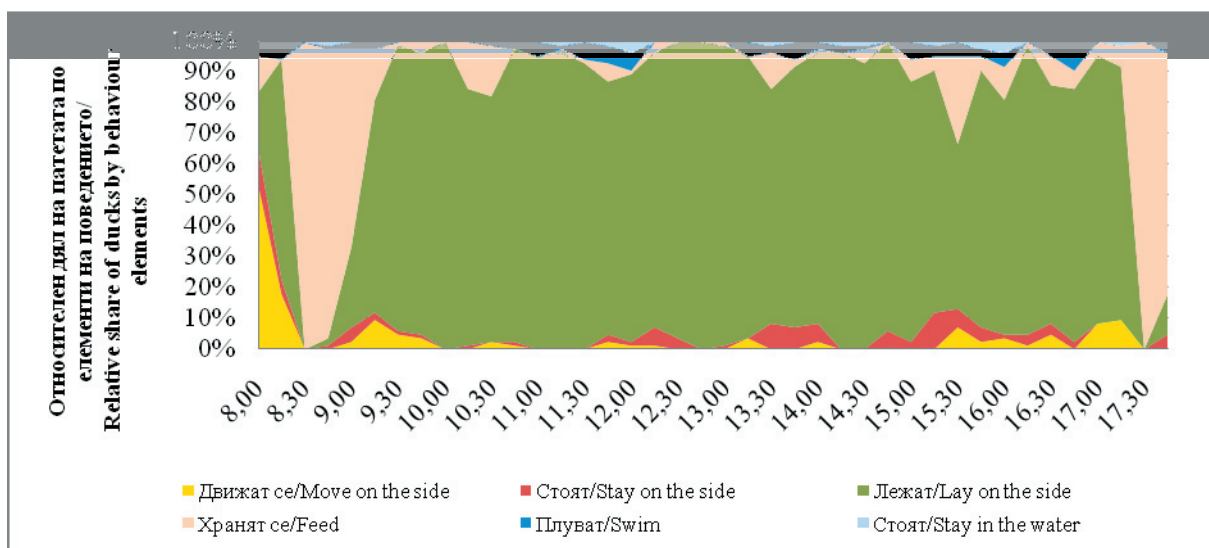
The ethogram at 4 weeks' age (Fig. 1) has been characterized by the most significant dynamics of behavioral elements within the limits of the experiment.

In the morning hours the ducks have had a greater motion activity on dry land, peak levels being registered within the period 8-9 a.m. (21.43%) and 10-11 a.m. (67.26%). After 11 a.m., the greater part of the time the ducks have spent at rest on the dike of the fish-pond. The highest relative share of the ethological element has been registered within the period 2-3 p.m. (86.61%), and the maximum quantity of ducks at rest – 96.4% has been registered at 2.15 p.m. The ducks have reacted actively on supplying food on feeding-troughs and the morning food supply has been accompanied by motion activity increase



Фигура 1. Динамика на елементите на поведение на мюларите на 4-седмична възраст.

Fig. 1. Dynamics of behavior elements of mule ducks at 4 weeks of age



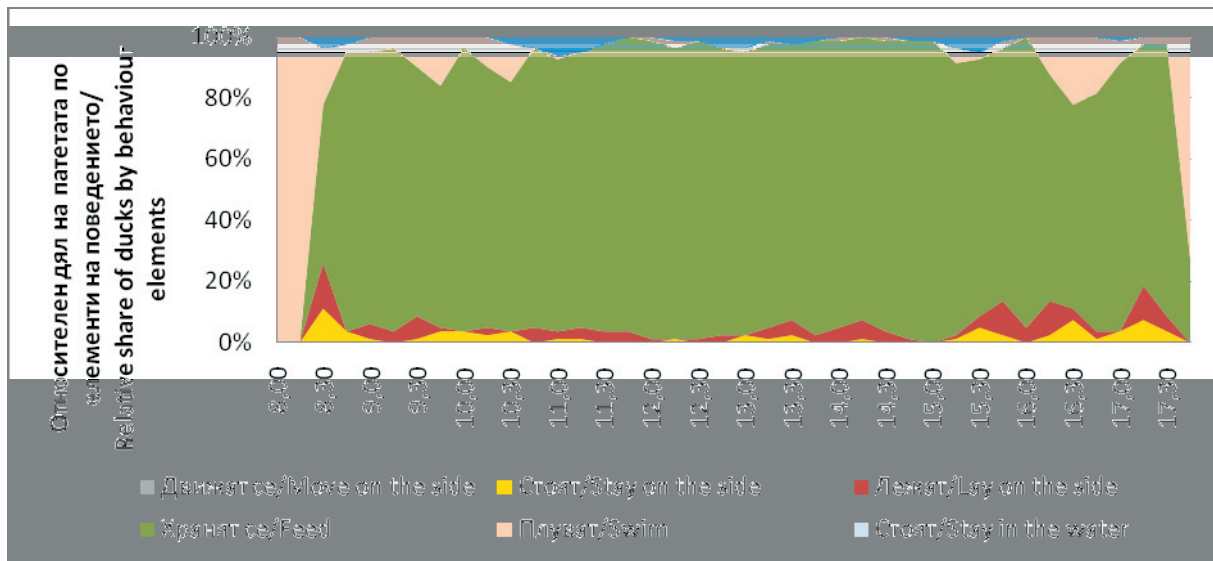
Фигура 2. Динамика на елементите на поведение на мюларите на 5-седмична възраст.

Fig. 2. Dynamics of behavior elements of mule ducks at 5 weeks of age

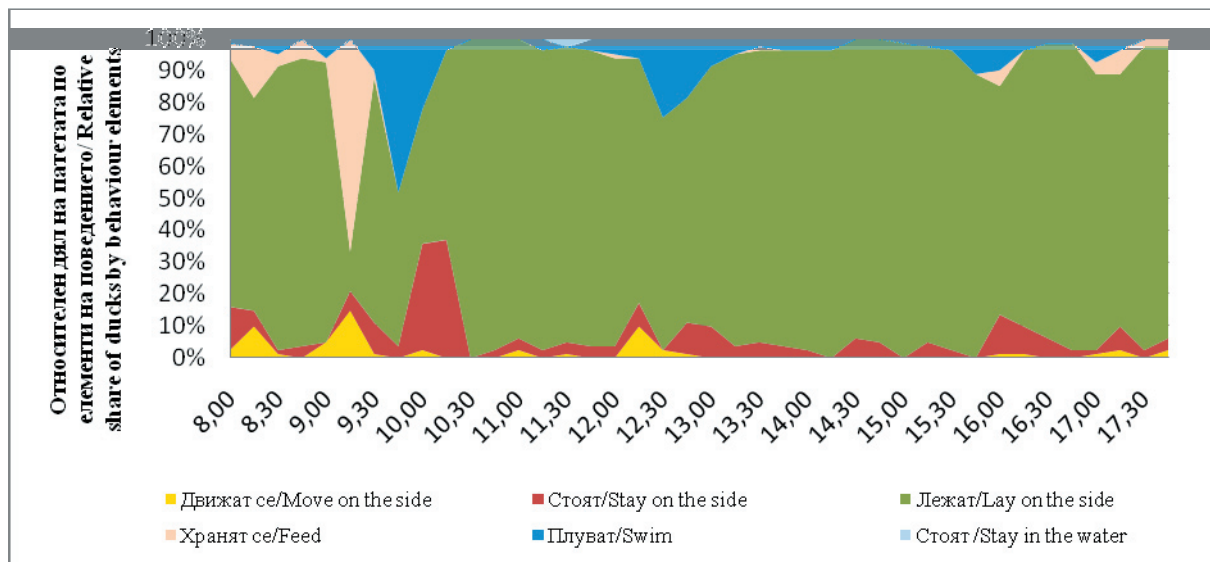
on dry land. The ducks comparatively actively enter the fish-pond at the age analyzed. At 70% of the registrations there have been ducks in the water. The greatest number of ducks with active behavior in the water – 15.5% has been registered within the period 8.45 – 9.15 a.m., and of ducks at rest in the fish-pond (6%) during different hours of the day (9 a.m., 11.45a.m., 3.30 p.m.).

The ethogram at 5-weeks' age (Fig. 2) demonstrates the total motion activity decrease of ducks as regards the previous observation. The most significant motion

on dry land has been registered at the beginning of the observation, within the period 8-9 a.m. (17.86%), while the maximum motion activity has been 53.6%. The motion activity, in general (swimming, nutrition, motion on dry land) has increased after 3 p.m. At the age specified, the ducks have used comparatively little the fish-pond. The time spent at rest in the fish-pond has been less than the previous period (max 3.6%) and the highest relative share of swimming has been 4.46 and 4.76%, registered, respectively within the period 11-12



Фигура 3. Динамика на елементите на поведение на мюларите на 6-седмична възраст.  
 Fig. 3. Dynamics of behavior elements of mule ducks at 6 weeks of age



Фигура 4. Динамика на елементите на поведение на мюларите на 7-седмична възраст.  
 Fig. 4. Dynamics of behavior elements of mule ducks at 7 weeks of age

DAILY DYNAMICS OF THE ELEMENTS OF MULE DUCKS BEHAVIOR AT A DIFFERENT AGE, BRED IN INTEGRATED FISH PONDS UNDER DIFFERENT NUTRIENT REGIMES.  
I. AT FEEDING WITH BALANCED COMMERCIAL MIXTURE.

Таблица 1. Часова динамика на елементите на поведението на мюларите на различна възраст  
Table 1. Hour dynamics of behavior elements of mule ducks at different age

Час Hour	Елементи на поведението / Behaviour elements											
	На сушата / on the side						В басейна / in the water					
	Движат се/ Move on the side		Стоят/ Stay on the side		Лежат/ Lay on the side		Хранят се/ Feed		Плуват/ Swim		Лежат/ Stay in the water	
	min.h <sup>-1</sup>	%	min.h <sup>-1</sup>	%	min.h <sup>-1</sup>	%	min.h <sup>-1</sup>	%	min.h <sup>-1</sup>	%	min.h <sup>-1</sup>	%
4-седмична възраст / 4 weeks of age												
8-9	12.86	21.43	21.25	35.42	21.43	35.71	0.54	0.89	3.75	6.25	0.18	0.30
9-10	2.14	3.57	10.54	17.56	24.82	41.37	17.32	28.87	4.29	7.14	0.89	1.49
10-11	40.36	67.26	3.93	6.55	14.29	23.81	0.00	0.00	1.43	2.38	0.00	0.00
11-12	1.96	3.27	3.75	6.25	46.43	77.38	3.75	6.25	2.86	4.76	1.25	2.08
12-13	2.32	3.87	3.21	5.36	47.68	79.46	2.14	3.57	3.39	5.65	1.25	2.08
13-14	1.25	2.08	3.75	6.25	49.82	83.04	1.07	1.79	2.14	3.57	1.96	3.27
14-15	1.07	1.79	1.25	2.08	51.96	86.61	3.04	5.06	1.61	2.68	1.07	1.79
15-16	3.21	5.36	5.54	9.23	40.36	67.26	3.57	5.95	4.82	8.04	2.50	4.17
16-17	1.96	3.27	2.14	3.57	35.18	58.63	17.32	28.87	2.32	3.87	1.07	1.79
17-18	2.86	4.76	10.18	16.96	38.39	63.99	5.89	9.82	1.43	2.38	1.25	2.08
5-седмична възраст / 5 weeks of age												
8-9	10.71	17.86	2.68	4.46	13.75	22.92	30.89	51.49	1.79	2.98	0.18	0.30
9-10	3.04	5.06	1.43	2.38	41.96	69.94	12.86	21.43	0.71	1.19	0.00	0.00
10-11	0.54	0.89	0.36	0.60	53.75	89.58	4.82	8.04	0.54	0.89	0.00	0.00
11-12	0.36	0.60	0.36	0.60	55.00	91.67	1.25	2.08	2.68	4.46	0.36	0.60
12-13	0.36	0.60	1.61	2.68	55.89	93.15	0.71	1.19	0.89	1.49	0.54	0.89
13-14	0.54	0.89	2.50	4.17	52.50	87.50	2.32	3.87	1.96	3.27	0.18	0.30
14-15	0.36	0.60	1.79	2.98	55.71	92.86	0.89	1.49	0.89	1.49	0.36	0.60
15-16	1.43	2.38	3.75	6.25	45.00	75.00	6.79	11.31	2.50	4.17	0.54	0.89
16-17	1.43	2.38	1.61	2.68	49.46	82.44	4.11	6.85	2.86	4.76	0.54	0.89
17-18	2.68	4.46	0.71	1.19	27.32	45.54	28.57	47.62	0.54	0.89	0.18	0.3
6-седмична възраст / 6 weeks of age												
8-9	2.22	3.70	2.22	3.70	21.48	35.80	33.15	55.25	0.93	1.54	0.00	0.00
9-10	0.93	1.54	2.59	4.32	51.30	85.49	5.19	8.64	0.00	0.00	0.00	0.00
10-11	1.48	2.47	1.11	1.85	52.59	87.65	3.89	6.48	0.93	1.54	0.00	0.00
11-12	0.37	0.62	2.04	3.40	55.37	92.28	0.19	0.31	2.04	3.40	0.00	0.00
12-13	0.19	0.31	0.74	1.23	57.59	95.99	0.56	0.93	0.93	1.54	0.00	0.00
13-14	0.93	1.54	1.67	2.78	55.74	92.90	0.37	0.62	1.30	2.16	0.00	0.00
14-15	0.19	0.31	2.41	4.01	56.85	94.75	0.37	0.62	0.19	0.31	0.00	0.00
15-16	1.30	2.16	2.41	4.01	53.15	88.58	1.48	2.47	1.67	2.78	0.00	0.00
16-17	1.67	2.78	3.33	5.56	47.04	78.40	7.96	13.27	0.00	0.00	0.00	0.00
17-18	2.22	3.70	2.41	4.01	42.41	70.68	12.78	21.30	0.19	0.31	0.00	0.00
7 седмична възраст / 7 weeks of age												
8-9	2.04	3.40	3.52	5.86	48.52	80.86	4.63	7.72	1.30	2.16	0.00	0.00
9-10	3.15	5.25	2.96	4.94	33.70	56.17	10.56	17.59	9.63	16.05	0.00	0.00
10-11	0.37	0.62	10.93	18.21	44.81	74.69	0.00	0.00	3.89	6.48	0.00	0.00
11-12	0.56	0.93	2.04	3.40	55.93	93.21	0.00	0.00	1.11	1.85	0.37	0.62
12-13	2.04	3.40	3.15	5.25	46.48	77.47	0.19	0.31	8.15	13.58	0.00	0.00
13-14	0.00	0.00	3.33	5.56	53.52	89.20	0.19	0.31	2.96	4.94	0.00	0.00
14-15	0.00	0.00	2.04	3.40	56.85	94.75	0.00	0.00	1.11	1.85	0.00	0.00
15-16	0.00	0.00	1.11	1.85	56.11	93.52	0.00	0.00	2.78	4.63	0.00	0.00
16-17	0.37	0.62	4.44	7.41	52.04	86.73	0.74	1.23	2.41	4.01	0.00	0.00
17-18	0.93	1.54	2.22	3.70	52.78	87.96	2.41	4.01	1.67	2.78	0.00	0.00
8-седмична възраст / 8 weeks of age												
8-9	1.10	1.83	7.32	12.20	40.79	67.99	10.79	17.99	0.00	0.00	0.00	0.00
9-10	3.11	5.18	3.11	5.18	45.37	75.61	8.41	14.02	0.00	0.00	0.00	0.00
10-11	0.37	0.61	0.91	1.52	57.99	96.65	0.73	1.22	0.00	0.00	0.00	0.00
11-12	0.37	0.61	0.18	0.30	59.45	99.09	0.00	0.00	0.00	0.00	0.00	0.00
12-13	0.73	1.22	0.18	0.30	55.43	92.38	0.18	0.30	2.74	4.57	0.73	1.22
13-14	0.55	0.91	4.21	7.01	52.13	86.89	1.65	2.74	1.46	2.44	0.00	0.00
14-15	1.10	1.83	1.46	2.44	54.51	90.85	2.38	3.96	0.55	0.91	0.00	0.00
15-16	1.28	2.13	1.83	3.05	52.32	87.20	4.21	7.01	0.37	0.61	0.00	0.00
16-17	3.84	6.40	4.76	7.93	45.18	75.30	6.22	10.37	0.00	0.00	0.00	0.00
17-18	0.91	1.52	17.38	28.96	38.41	64.02	3.11	5.18	0.18	0.30	0.00	0.00



a.m. and 4-5 p.m. In general, during the period analyzed, the most significant part of the time (75.1%) have been spent by the ducks at rest on the dike of the fish-pond. At two of the registrations, all the ducks have been at rest on dry land.

At 6 weeks` age, the motion activity of the ducks has been still weaker. With the exception of the periods, in which the ducks have been actively fed, the greater part of the day has been spent by them at rest on the embankment of the fish-pond (from 35.8% to 95.9% of the time). No ducks have been registered at rest in the water (Fig. 3) at all observations. A comparatively increased activity of ducks in the water has been registered within the period from 10.30 a.m. till 11.30 a.m., but the maximum relative share of the element has been 6.2%, registered at 11 a.m.

The ethogram at 7-weeks` age has been characterized by increased ducks activity in the water (Fig. 4). During this observation the highest for the period of the experiment relative share of swimming – 48.1% has been registered. The increased values of activity have been registered between 9.30 a.m. and 10 a.m. The second peak has been observed at noon – from 12 a.m. till 1 p.m. In the afternoon (after 3.30 p.m.) the time spent by the ducks in swimming has also increased. The ethogram has shown that in general, the motion activity has been higher during the first part of the day when a more active feeding behavior has been observed, as well.

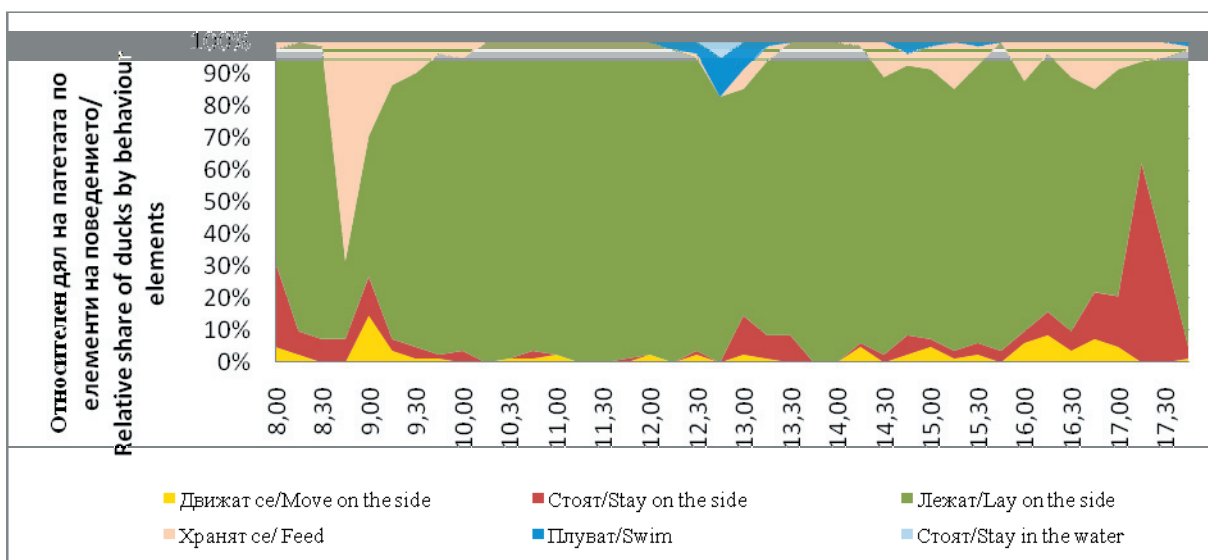
The observation at 8 weeks` age has differed from the previous ones by a considerable reduction of time spent

by the ducks in the water. The first ducks which have entered the fish-pond have been registered after 12 a.m. During the whole period of observation, the ducks have stayed mainly on dry land, and within the period 11 a.m. till 12 a.m. all the ducks have been at rest upon the dike of the fish-pond.

The comparison among the separate ethograms has shown that age differences have been observed either as regards reaction to food supply on the embankment or as regards the feeding behavior, in general. Together with age advance, ducks have reacted weaker to food supply, the most active feeding behavior has been demonstrated in the morning hours. Besides as regards the feeding behavior, age differences have been observed as regards the motion activity, as well. A more considerable motion activity has been registered concerning younger age and together with the fattening period advance it has decreased.

A number of investigations upon birds behavior bred at conditions of free-range technologies have shown that when fed on full-ration mixtures the birds do not use actively the free spaces available. So, Dawking et al. [2] have established that when breeding chicken-broilers in commercial free-range systems, most of the birds do not go out into the free spaces in front of the buildings, but they prefer to stay inside.

At the conditions of our experiment the mule ducks have preferred to spend their time at rest upon the fish-pond dike. They used to go into the water for a short time, and the time reported for swimming has been 9.63 min.h<sup>-1</sup>,



Фигура 5. Динамика на елементите на поведение на мюларите на 8-седмична възраст.

Fig. 5. Dynamics of behavior elements of mule ducks at 8 weeks of age

and the time spent at rest in the water has not surpassed 2.5 min.h<sup>-1</sup>. In that way, full-ration mixture feeding has not stimulated the active search for food, the fish-pond resources have not been completely utilized, and the meliorative effect of ducks in the fish-pond has been insignificant. As regards ducks themselves, the technology tested has ensured favorable conditions, because demonstrations of aggression and cannibalism, the main problems in their breeding in intensive conditions, have not been observed.

## CONCLUSION

Concerning ducks breeding technology tested, favorable conditions for breeding have been ensured but the effect of birds upon fish-pond ecosystem has been minimal. Mule ducks nutrition with full-ration factory-made mixtures has not stimulated active search for food in the fish-ponds. Ducks used to enter the water for a short time, and the time for swimming reported has been 9.63 min.h<sup>-1</sup> while the time spent at rest in the water has not surpassed 2.5 min.h<sup>-1</sup>. Age differences concerning behavior have been observed. With the advance of the fattening period, in general, the motion activity has decreased, ducks have reacted weaker to forage supply, and the forages have been consumed more actively during the morning hours.

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