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EFFECT OF SEASONAL VARIATION ON ABUNDANCE AND SEX RATIO DISTRIBUTION OF THE FISH FAUNA OF IKERE GORGE, OYO STATE, NIGERIA

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ABSTRACT: *The study determined the effect of season on abundance and sex ratio of fish fauna from Ikere-gorge. Fish composition, distribution and abundance were determined. Sexes were also determined and sex ratio calculated. 5,736 fish specimens were caught, identified and classified into 34 species, from 13 families. Chrysichthyes nigrodigitatus was densely and least distributed in station IV (29.98%), and III (19.87%). Lates niloticus was more in station III (3.81%) but significantly lower ($p<0.05$) than C. nigrodigitatus and Tilapia melanopleura in station 2. C. nigrodigitatus and Sarotherodon galilaeus were present in all sampling months. Sex ratio was skewed in favour of the female populations for C. nigrodigitatus, T. melanopleura and S. galilaeus but towards male for L. niloticus population. No seasonal variation was observed in sex ratio of the species. Conclusively, C. nigrodigitatus, T. melanopleura and S. galilaeus are not threatened in this water but same could not be said for L. niloticus.*

KEY WORDS: *Chrysichthyes nigrodigitatus,* distribution, Fish composition, *Lates niloticus, Sarotherodon galilaeus, Tilapia melanopleura*

INTRODUCTION

Sex population is the estimation of the abundance of any sex at any particular time under natural condition. Sex ratio is a biological parameter that affects the growth rates and ecology of wild populations (Dyson & Hurst, 2004), and it is fundamental to a sexually reproducing population (Gusmão, McKinnon & Richardson, 2013). Adult sex ratio, that is the proportion of sexually mature males and females in a population, is a key demographic parameter (Le Galliard, Fitze, Ferrière & Clobert, 2005). There had been several report on the skewedness of sex ration in favour of either male or female population.

Food availability, predation, differential parental care, sex-specific differences in longevity or mortality, and even sex change can affect sex determination and resulting sex ratios (Jiménez-Melero, Gilbert & Guerrero, 2014; Fryxell, Arnett, Apgar, Kinnison & Palkovacs 2015). Skewed sex ratios are often observed in nature, across the tree of life and reasons attributed to the aforementioned. Also, among the various traits of natural populations, sex ratio is one of the most studied, and the theory of sex allocation is one of the most successful theories in evolutionary ecology (Gusmão et al., 2013).

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Previous documentation on the reproductive biology of wild fish species had been reported. Reichard, Polacik, Blazek & Vrtılek (2014) on female bias in the adult sex ratio of African annual fishes. Seasonal changes in size, sex-ratio and body condition of the damselfish *Chromis chromis* in the central Mediterranean Sea (Bracciali, Piovano, Gianluca & Giacoma 2014). Mian *et al*. (2017) on some reproductive aspects of freshwater Garfish, *Xenentodon cancila* from North-East Bangladesh. Adite, Megnisse, Gbaguidi & Ategbo (2017) reported on the reproductive biology and life history patterns of the Claroteid, *Chrysichthys nigrodigitatus* from a man-made Lake in Southern Benin.

Since sex ratio can be used to determine the population growth rates and ecology trajectories of a wild population, gaining a better understanding of the population structure of the fish abundance especially of economically important species, as well as of the sex variations occurring throughout the year in, may be very useful in ensuring the early detection of environmental changes, and also for devising better management and conservation practices of natural water bodies. Also, knowledge of the sex ratio of fishes is important and provides information necessary in assessing the reproductive potential of any population (Jega et al., 2017). There is however, paucity of information on the distribution of fish sexes from this water body. Thus, the needs to estimate the sex proportion of the fish species in Ikere gorge. This study was designed to estimate the seasonal variation in the sex ratio of some economically important fish species from Ikere gorge, Oyo State.

MATERIALS AND METHODS

Study area

Ikere gorge is a man- made lake located in Ikere River, 8 kilometers east of Ikere village and 30 kilometers North east of Iseyin in Oyo state, Nigeria. Ikere River takes its source between longitude 8^{o} 10′ and 8^{o} 20′E and latitude 3^{o}40′ and 3^{o} 50′N. The reservoir has a capacity of 690 million m^3 and a surface area of 47 km^2.

Samples were collected from four locations in the study area (Figure 1) using ecological and hydrological characteristics and intensity of fishing activity as criteria.
Station 1. This is the dam site of the gorge. Fishing villages selected were: Benue camp, Ilaje camp and Egun camp.

Station 2. Covers the Ikere river channel, which consists of flooded bush patches. Fishing villages selected include Abugaga, Elelu, Idoma and Hausa camp.

Station 3. This is open water that covers the in-shore and offshore area occupied by the central or middle portion of the gorge. Fishing villages selected include Aba-asamu and Togolis camp.

Station 4. Covers the shallow bays location of the gorge, this is an intake tower of the gorge. The two fishing villages selected were: Bendel and Agatu camp respectively.

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Sampling Method

Sampling locations were selected using purposive sampling. Sampling of each station for fish composition and abundance was done on a monthly bases using a fleet of eight graded experimental gillnets (mesh sizes 25.4, 38.1, 50.8, 63.5, 76.0, 88.5, 126.4 and 177.2 millimeters) and cast net (50.8mm) of similar surface area. Samples were taken on the first three days of the first week of every month covering eighteen calendar months of wet and dry months. Gears were set at dusk and retrieved at dawn in all stations, the investigation were carried out from landings site. The nets were set in different ecological zones in open water, flooded bush patches and shallow bays. Catches were also collected from long-lines, fish traps, and hollow cylinders made from bamboo and set hooks to provide a comprehensive picture of fish species in the lake.

Fish composition, Distribution and Abundance

Catch from landings were enumerated, examined, sorted to species level, record the weight, length and biomass number of fish species. Catches were labeled according to locations as station 1, 2, 3, and 4 and conveyed to the laboratory of the Department of Aquaculture and Fisheries Management in ice-chest for further studies. Fish samples were identified using taxonomic keys (Olaosebikan & Raji, 1988). Species representation in each station was analyzed.

Sex Ratio

Sexes of species of economic importance (*Chrysichthys nigrodigitatus, Lates niloticus and Tilapia* spp.) were determined according to Bahrami, Ghaderi & Hoseinpour (2015).

The sexes of the sampled fish species were visually determined by the inspection of the gonads. While some samples could easily be discerned by mere observation of the reproductive organs, others were observed by making slits on the ventral side of the fish to expose the gonads. For very small fish specimens, magnifying glasses were often used. Records of observations were kept.

RESULTS

Fish Species and Harvest Composition

A total of 5,736 fish specimens were caught during the eighteen months of study. These were identified and classified into 34 species belonging to 13 families. Percentage species composition in the harvests of the experimental gillnet is presented in Figure 2,3,4 and 5. In the four stations of the study area, over 29 fish species were encountered in station III, followed by 27 fish species in station IV, 26 fish species in station I and 24 in station II. A few fish species whose identification were not known and whose utility were highly negligible were however not included in the result.

Distribution and Relative Abundance

C. nigrodigitatus was more densely distributed in station IV (29.98%), while station III had the least abundance (19.87%). There was no significant difference ($p>0.05$) in the mean abundance of the species in all the four stations. *C. nigrodigitatus* was however,

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significantly higher than all the other three commercial species in all the stations (Figure 2-5). The species preponderance was more in the shallow bay (station 4) of the gorge (Table 1). *L. niloticus* was more densely distributed in station III (3.81%) but it was significantly lower ($p<0.05$) than the mean abundance of *C. nigrodigitatus* and *T. melanopleura* in station 2.

Figure 6 revealed seasonal variation in abundance of the four commercial fish species. *C. nigrodigitatus* and *Sarotherodon galilaeus* were observed to be present in all sampling months. *C. nigrodigitatus* was more abundant in the dry months especially November-January than in the wet months. The Cichlids were in abundance in the wet months, onset and outset of the rain than in the dry months.

Sex Ratio of the commercial species of the study area

C. nigrodigitatus

1423 specimens of *C. nigrodigitatus* were examined. 606 were males while 817 were females. Table 2 showed monthly variation in sex ratio during the sampling period.

Lates niloticus

Lates niloticus commonly known as Niger/Nile Perch is endemic to Ikere River before its impoundment and it was successfully established throughout the gorge after impoundment. 170 specimens of *L. niloticus* were examined. 93 were males while 77 were females. Table 3 showed monthly variation in sex ratio during the sampling period. The result showed that more male predominates throughout the months of the year. However, increase in the number of females was observed during the months of August to December.

Cichlids

Tilapia melanopleura, and *Sarotherodon galilaeus* represented the Cichlids Sex ratio of *T. melanopleura* pooled from all four stations was very close to 1. A total number of 596 specimens of *T. melanopleura* were examined. Throughout the sampling period, the numbers of females were always higher than that of the males (Table 4). All the examined fish samples had observable gonads. There were fluctuations in the sex ratio from month to month.

Sarotherodon galilaeus

Table 5 showed that the sex ratio of *S. galilaeus* from all four stations was very close to 1. Of 432 specimens of *S. galilaeus* examined, 154 were males while 278 were females. Most often during the sampling period, the numbers of females were always higher than that of the males. All the examined fish samples had observable gonads.

Discussion

Availability of *C. nigrodigitatus*,and *S. galilaeus* all year round indicate the suitability of the water characteristics for their growth and survival. It could also be attributed to the availability of food to meet their nutrient requirements. This finding corroborated that reported by Oluwajoba et al., (2017) for these species from the Lagos lagoon. This was not the case with the report of Olukolajo & Oluwaseun (2008) who reported the presence of C.

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nigrodigitatus from a lagoon in South-West, Nigeria in the wet months of the year. Reasons for this variation mabe attributed to the differences in the water quality and food abundance. Other species that were highly abundant at the peak of the dry season is *Marcusenius isidoris,* though not a commercial fish species was observed to be high in abundance in the dry months (October - March) and at the onset of the rainy months (April and May) than at the peaks of the wet months. The high abundance in the onset of the wet months could be due to the beginning of the breeding season for the species. Akongyuure, Amisah & Edziyie (2017) reported all year abundance of the species in the in the Tono reservoir, Northern Ghana.

The Cichlids *Hemichromis fasciatus, Tilapia melanopleura* and *Tilapia macrocephala* were more in abundance during the wet season than the dry season. Although they were distributed in this water body virtually all year round. Reasons could be attributable to the breeding season of these species which has been reported to occur all year round (Faunce, 2000; Mireku, Blaya & Yankson, 2016).

Female predominated throughout the months of the year among the commercial fish species in the area with exception of *Lates niloticus*. However, there were no variations in the monthly sex ratio monitored all through the study as both high and low ratios were observed in both the wet and dry months of the study. This was however not the case in the study of (Komolafe & Arawomo, 2011) who reported a higher male to female sex ratio among the Cichlids from Erinle reservoir, Osun State, Nigeria. Skewed sex ratio in favour of one sex has been reported to be a sign of declining wild populations and threat of extinction of the species.

C. *nigrodigitatus,* revealed lowest sex ratio in the month of January and highest ratio of M: F was recorded in June. This showed that more females were significantly present than males and agreed with the result of Kusemiju & Olaniya (1989) who reported a sex ratio of 1 male to 1.27 females in Lagos lagoon and Imevbore (1970) who obtained a sex ratio of 1 male to1.40 females. This result was however in disagreement with the findings of Akintade, Edwin & Simon (2016) who reported higher male populations of the silver catfish (C. *nigrodigitatus*) and for *Tilapia melanotheron* from Badagry creek, Lagos. Offem, Akegbejo-Samsons & Omoniyi (2008) also reported similar findings from a water body in Cross River, Nigeria.

Implication to research and practice

The finding of this study implies that sexes of fish captured from the wild can be used to determine the abundance of the species in any water body. Thus, to manage fish species of high economic importance, fishermen activities in terms of sexes of species captured should be monitored.

CONCLUSION

The fish fauna from Ikere gorge showed negligible variations in the catch composition from the various locations sampled. Species such as *C. nigrodigitatus* and the Cichlids (*S.*

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galilaeus, Hemichromis fasciatus, *Tilapia melanopleura* and *Tilapia macrocephala*) were present all year round. There were no seasonal variations in sex ratio of these species, however, preponderance of female was recorded for the species of commercial interest with exception of *Lates niloticus*

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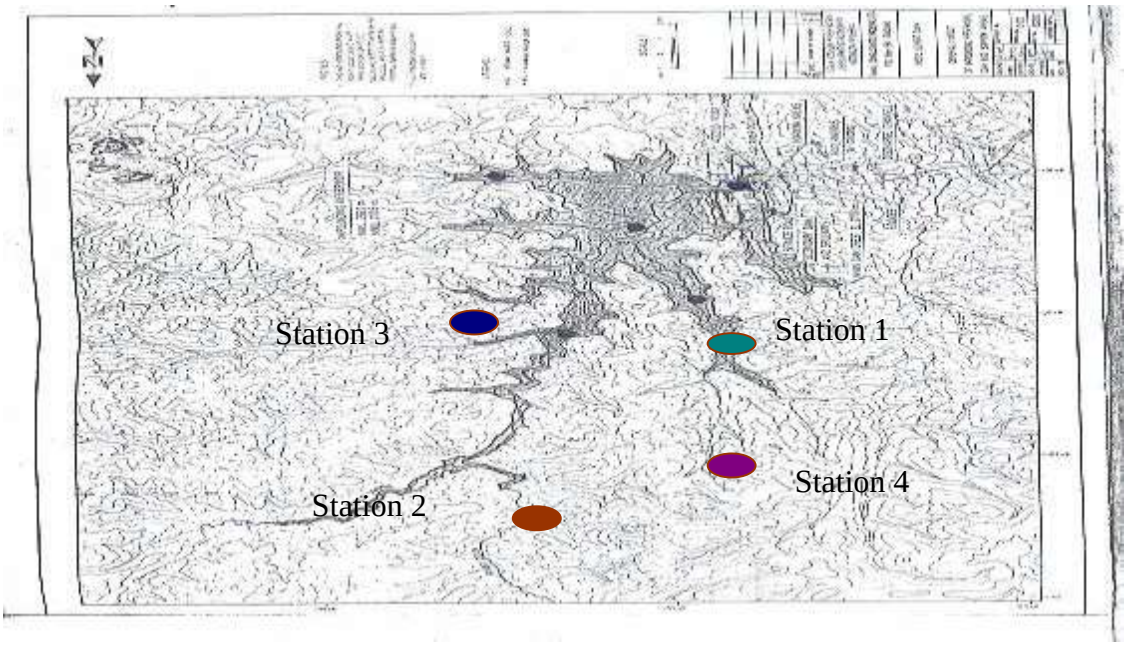

Figure 1: Map of Ikere gorge showing sampling locations

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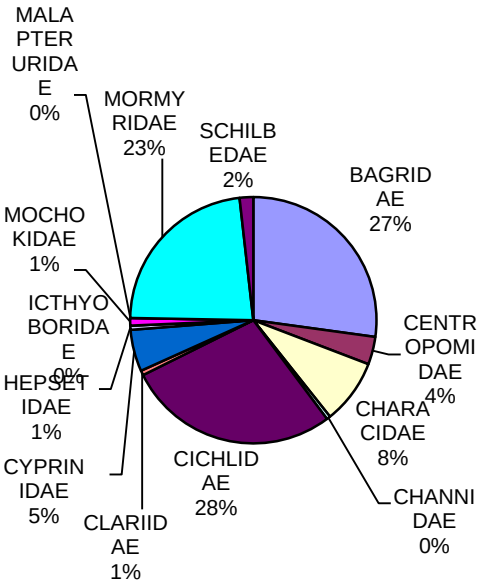

Figure 2: Station 1 fish species composition (%)

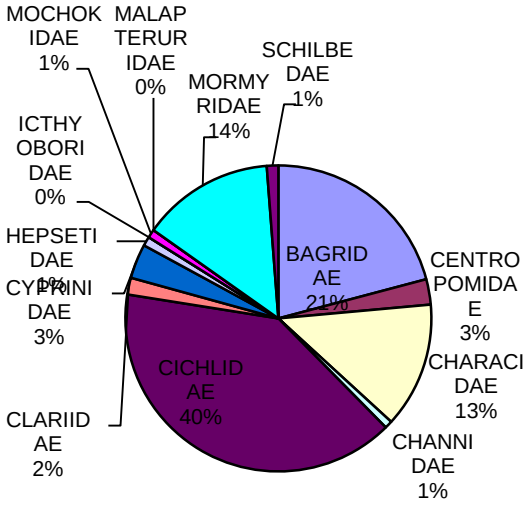

Figure 3: Station 2 fish species composition (%)

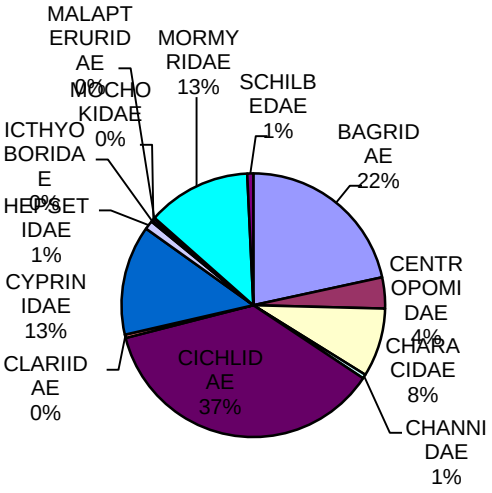

Figure 4: Station 3 fish species composition (%)

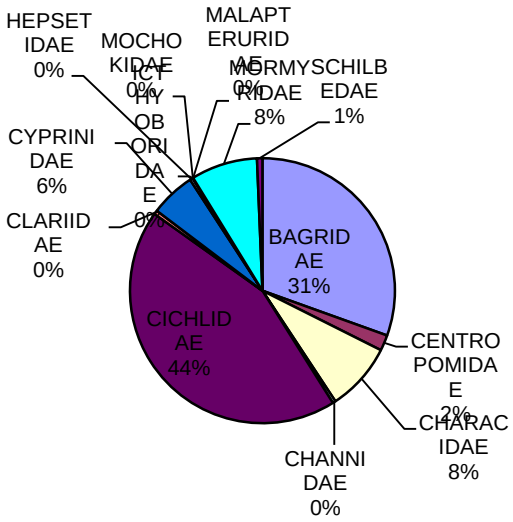

Figure 5: Station 4 fish species composition (%)

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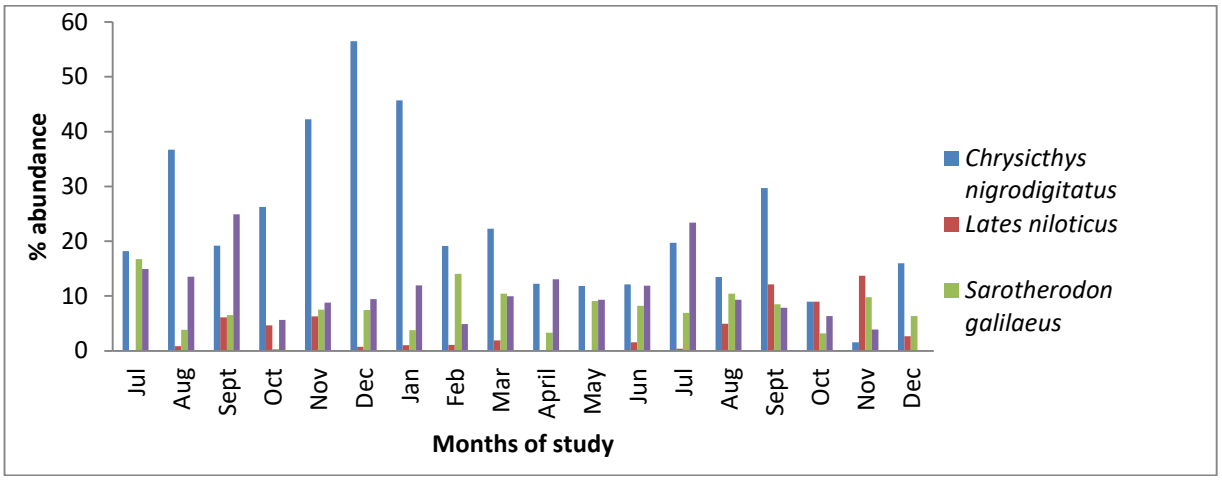

Figure 6: Seasonal variation in abundance of the four commercial fish species of the gorge

List of Tables

Table 1: Comparative analysis of mean percentage abundance of the commercial species of Ikere gorge at various sampling station

Species	Station 1	Station 2	Station 3	Station 4
Chrisichthys nigrodigitatus	1.49±0.70[a]	1.12±0.20[a]	1.10±0.29[a]	1.67±0.68[a]
Lates niloticus	0.20±0.07[a]	0.15±0.05[a]	0.21±0.06[a]	0.11±0.03[a]
Tilapia melanopleura	0.41±0.12[a]	0.64±0.15[a]	0.83±0.20[a]	0.51±0.09[a]
Sarotherodon galilaeus	0.04±0.02[a]	0.02±0.01[a]	0.05±0.03[a]	0.04±0.03[a]

Table 2: Seasonal variation in sex ratio of *Chrysichthys nigrodigitatus* in Ikere gorge

Month	Total no. of specimen	Males	Females	Ratio (M : F)
July	93	31	62	1 : 2
August	111	34	77	1 : 2
September	67	15	52	1 : 3.5
October	99	32	67	1 : 2
November	69	16	53	1 : 3.3
December	140	30	110	1 : 4.9
January	98	8	90	1 : 11.2
February	86	12	74	1 : 6.2
March	66	15	51	1 : 3.4
April	68	20	48	1 : 2.4
May	69	24	45	1 : 1.88
June	76	33	45	1 : 1.4
July	78	11	67	1 : 6.1
August	72	29	43	1 : 1.48
September	73	19	54	1 : 3

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October	47	12	35	1 : 2.6
November	39	13	26	1 : 2
December	72	18	54	1 : 3
Total	1423	606	817	1 : 1.4/3.5

Table 3: Seasonal variation in sex ratio in *Lates niloticus* in Ikere gorge

Month	Male	Female	Total	Ratio (M : F)
July	-	-	-	-
August	4	1	5	4 : 1
September	8	6	14	1.3 : 1
October	7	6	13	1.2 : 1
November	7	7	14	1 : 1
December	4	1	5	4 : 1
January	5	2	7	2.5 : 1
February	4	1	5	4 : 1
March	5	1	6	5 : 1
April	-	-	-	-
May	-	-	-	-
June	5	2	7	2.5 : 1
July	-	1	1	0 : 1
August	9	8	17	1.1 : 1
September	9	10	19	1 : 1.1
October	7	8	15	1 : 1.1
November	13	18	31	1 : 1.4
December	6	5	11	1.2 : 1
Total	93	77	170	1.2/2.1 : 1

Table 4: Seasonal variation in sex ratio of *T. melanopleura* during the study

Month	Male	Female	Total	Ratio (M:F)
July	24	17	41	1:1
August	13	19	32	1:2
September	17	44	61	1:2
October	7	10	17	1:2
November	6	15	21	1:2
December	23	29	52	1:1
January	22	48	70	1:2
February	7	11	18	1:2
March	12	9	21	1:1
April	26	21	47	1:1
May	19	15	34	1:1
June	30	25	55	1:1
July	34	24	58	1:1
August	9	25	34	1:2
September	4	9	13	1:2

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October	4	8	12	1:2
November	5	5	10	1:1
December	-	-	-	-
Total	262	334	596	1:1.5

Table 5: Seasonal variation in sex Ratio of *S. galilaeus*

Month	Male	Female	Total	Ratio (M : F)
July	2	4	6	1 : 2
August	3	7	10	1 : 2.3
September	3	6	9	1 : 2
October	11	23	34	1 : 2.1
November	10	21	21	1 : 2.1
December	17	23	40	1 : 1.4
January	7	15	22	1 : 2
February	9	21	30	1 : 2.3
March	4	7	11	1 : 1.8
April	4	9	13	1 : 2.3
May	29	42	71	1 : 1.4
June	12	23	35	1 : 2
July	6	13	19	1 : 2
August	7	9	16	1 : 1.3
September	15	32	47	1 : 2.3
October	4	6	10	1 : 1.5
November	6	7	13	1 : 1.2
December	5	10	15	1 : 2
Total	154	278	432	1 : 1.9

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