## 9.3.33 Herring (*Clupea harengus*) in subareas 1, 2, and 5, and in divisions 4.a and 14.a, Norwegian spring-spawning herring (Northeast Atlantic)

### ICES stock advice

ICES advises that when the EU, Faroe Islands, Iceland, Norway, and Russia management plan is applied, catches in 2017 should be no more than 646 075 tonnes.

### Stock development over time

The stock is declining and estimated to be close to MSY $B_{trigger}$ in 2016. Since 1998 four large year classes have been produced (1998, 1999, 2002, and 2004). Year classes 2005–2012 are estimated to be small. The estimates of the year classes coming after the 2012 year class are uncertain. Fishing mortality in 2015 was well below $F_{MSY}$.

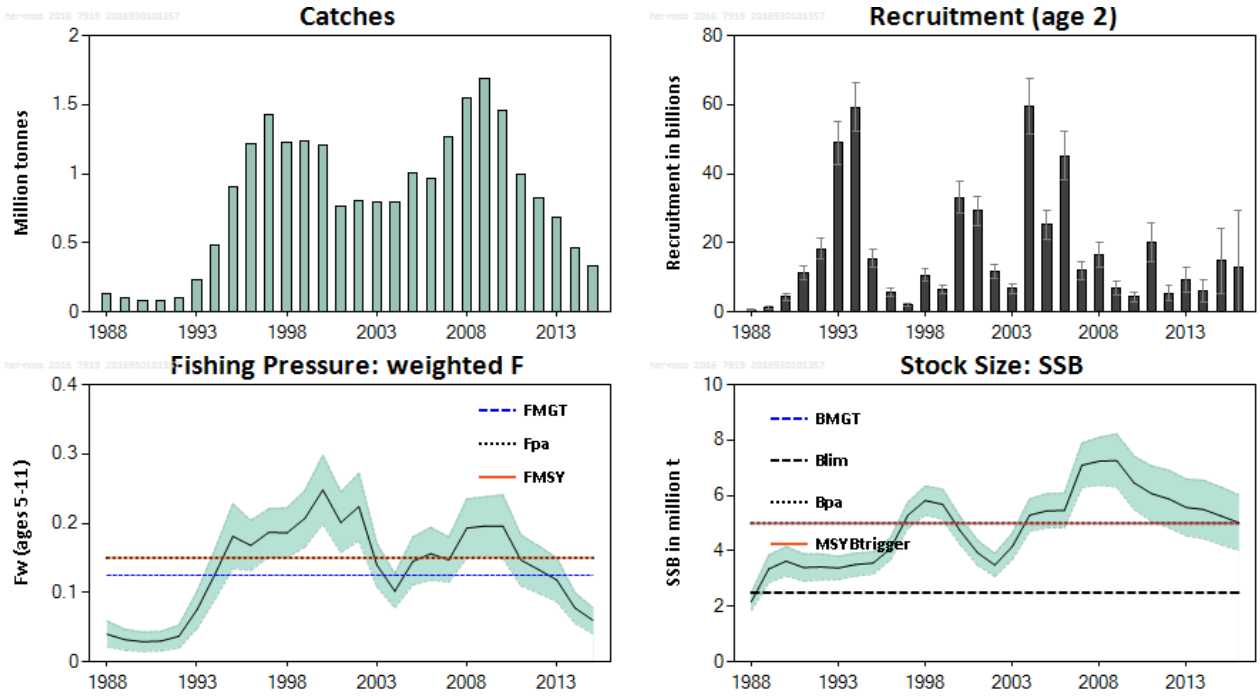


**Figure 9.3.33.1** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Summary of stock assessment. Confidence intervals (95%) are included in the recruitment, fishing mortality, and spawning stock biomass plots. $F_W$ is the fishing mortality weighted by the population numbers.

### Stock and exploitation status

**Table 9.3.33.1** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). State of the stock and fishery relative to reference points.

| | Fishing pressure | | | | Stock size | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2013 | 2014 | 2015 | | 2014 | 2015 | 2016 |
| Maximum sustainable yield | $F_{MSY}$ | ✓ | ✓ | ✓ Appropriate | MSY $B_{trigger}$ | ✓ | ✓ | ✓ At trigger |
| Precautionary approach | $F_{pa}$ | ✓ | ✓ | ✓ Harvested sustainably | $B_{pa}$, $B_{lim}$ | ✓ | ✓ | ✓ Full reproductive capacity |
| Management plan | $F_{MGT}$ | ✓ | ✓ | ✓ Appropriate | $SSB_{MGT}$ | ✓ | ✓ | ✓ At trigger |

## Catch options

**Table 9.3.33.2** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis for the catch options.

| Variable | Value | Source | Notes |
|---|---|---|---|
| F ages 5–11 (2016) | 0.063 | ICES (2016a) | Based on ICES estimated catches 2016. |
| SSB (2017) | 4974000 t | ICES (2016a) | |
| $R_{age2}$ (2016) | 13.015 billion | ICES (2016a) | Estimated by XSAM. |
| $R_{age2}$ (2017) | 12.034 billion | ICES (2016a) | Median of stochastic recruitment estimated by XSAM based on years 1988-2016. |
| Catch (2016) | 376612 t | ICES (2016a) | Sum of declared national quotas. |

**Table 9.3.33.3** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The catch options. Weights in tonnes.

| Rationale | Catches (2017) | Basis | $F_w$(2017)* | SSB(2018) | % SSB change** | % Catch change*** |
|---|---|---|---|---|---|---|
| Agreed management plan | 646075 | Harvest control rule^ | 0.124 | 4898000 | −2 | 72 |
| Other options | 766676 | ICES MSY approach: $F_{MSY}$* SSB(2017) / MSY $B_{trigger}$ | 0.149 | 4794000 | −4 | 104 |
| | 0 | F = 0 | 0 | 5459000 | 10 | −100 |
| | 339833 | $F_{2016}$ | 0.063 | 5163000 | 4 | −10 |
| | 770384 | $F_{MSY}$ (= $F_{pa}$) | 0.150 | 4791000 | −4 | 105 |
| | 528271 | $SSB_{2018}$ = $B_{pa}$ (= MSY $B_{trigger}$) | 0.100 | 5000000 | 1 | 40 |
| | 3493537 | $SSB_{2018}$ = $B_{lim}$ | 0.978 | 2500000 | −50 | 828 |

* $F_w$ = Fishing mortality weighted by population numbers (age groups 5–11).
** SSB 2018 relative to SSB 2017.
*** Catches 2017 relative to estimated catch 2016.
^ According to the harvest control rule in the management plan F(2017) = 0.125*(SSB(2017)-$B_{lim}$)/($B_{pa}$-$B_{lim}$) + 0.05*($B_{pa}$-SSB(2017))/($B_{pa}$-$B_{lim}$), where $B_{pa}$=5, $B_{lim}$=2.5 and SSB(2017)=4.974, expressed in million t.

## Basis of the advice

**Table 9.3.33.4** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis of the advice.

| | |
|---|---|
| Advice basis | Management plan. |
| Management plan | A long-term management plan was agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 (see Annex 9.3.11.1 in ICES, 2014). ICES has evaluated the plan and concluded that it is consistent with the precautionary approach (ICES, 2013a). |

## Quality of the assessment

The new assessment model XSAM is considered to improve the quality of the assessment as it accounts for error structure in the input data and provides results with estimates of uncertainty.

The perception of the stock has changed since last year's assessment (estimated SSB in 2015 is 33% higher in this year's assessment) mainly because of the high abundance indices from the spawning ground surveys in 2015 and 2016. A revision of the age-at-maturity data in this year's assessment (following WKPELA 2016; ICES, 2016b) resulted in changes in SSB estimates for the period 2006–2011. The current assessment shows a slower rate of decline in recent years compared to last year's assessment.

The stock estimates for recent years from exploratory runs with other models are within the confidence intervals of the current assessment.


**Figure 9.3.33.2** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Historical assessment results (final-year recruitment estimates included). Prior to the 2016 assessment, estimates of F refer to ages 5–14. Recruitment estimates from assessments conducted before 2016 are not shown as they refer to age 0 instead of age 2.

## Issues relevant for the advice

The catch advice for 2017 is considerably higher than for 2016 (104% increase), whereas the estimated SSB at the beginning of the TAC year is 39% higher in the current assessment when compared to last year's assessment. The increase in the catch advice is caused by (1) the upward revision of the stock size (see under Quality of the assessment), and (2) the management plan F being sensitive to the SSB estimate because of the linear reduction in fishing mortality when SSB is estimated to be below the management plan trigger $SSB_{MGT}$ of 5 million t. In last year's assessment SSB(2016) was estimated to be 28% below $SSB_{MGT}$. Last year, the application of the management plan resulted in an advised F of 0.083. The current assessment estimates the SSB(2017) to be 1% below the management plan trigger $SSB_{MGT}$, resulting in an advised F of 0.124.

The F in the management plan and reference points refers to ages 5–14, whereas the F from the current assessment is for ages 5–11. Whereas the impact of this change is expected to be relatively minor, a complete exploration will take place as part of a planned review of the management plan and reference points.

## Reference points

**Table 9.3.33.5** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Reference points, values, and their technical basis.

| Framework | Reference point | Value | Technical basis | Source |
|---|---|---|---|---|
| MSY approach | MSY $B_{trigger}$ | 5.0 million t | $B_{pa}$ | |
| | $F_{MSY}$ | 0.15 | Stochastic equilibrium analysis using a Beverton–Holt stock–recruitment relationship with data from 1950 to 2009. | ICES (2013b) |
| Precautionary approach | $B_{lim}$ | 2.5 million t | MBAL (accepted in 1998). | ICES (2013b) |
| | $B_{pa}$ | 5.0 million t | $B_{lim} \times \exp(0.4 \times 1.645)$. | ICES (2013b) |
| | $F_{lim}$ | Not defined. | - | |
| | $F_{pa}$ | 0.15 | Based on medium-term simulations. | ICES (2013b) |
| Management strategy | $SSB_{MGT}$ | 5.0 million t | Medium-term simulations conducted in 2001 and 2014. | ICES (2014) |
| | $F_{MGT}$ | 0.125 | Medium-term simulations conducted in 2001 and 2014. | ICES (2014) |

## Basis of the assessment

**Table 9.3.33.6** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis of the assessment.

| | |
|---|---|
| ICES stock data category | Category 1 (ICES, 2016c) |
| Assessment type | Statistical assessment model (XSAM; ICES, 2016a, 2016b) that uses catches in the model and in the forecast and also includes error structures in catches and abundance indices. |
| Input data | Assessment period 1988–2016: Commercial catches-at-age (stock weight-at-age from surveys and since 2009 from catch sampling). Three survey indices: Norwegian acoustic survey on spawning grounds in February/March (NASF, 1994–2005, 2015–2016); International Ecosystem Survey in the Nordic Seas (IESNS) covering the adult stock in the Nordic seas (1996–2016) and the juvenile stock in the Barents Sea (1991–2016). Maturity ogive variable by year-class strength. Natural mortalities are fixed values from historical analyses (age 2 = 0.9, ages greater than 3 = 0.15). |
| Discards and bycatch | Not included, considered negligible. |
| Indicators | None |
| Other information | This stock was benchmarked in 2016 (ICES, 2016b). A re-evaluation of reference points and the current management plan is scheduled for the autumn of 2016. |
| Working group | Working Group on Widely Distributed Stocks (WGWIDE) |

## Information from stakeholders

Over the last year the EU pelagic industry has conducted its fishery on the traditional fishing grounds. No changes in distribution have been observed. The fishery has been characterized by large shoals in both the January fishery and in the autumn season. Several year classes have been observed in catches.

## History of advice, catch, and management

**Table 9.3.33.7** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). History of ICES advice, the agreed TAC, and ICES estimates of catch. Weights in thousand tonnes.

| Year | ICES advice | Predicted catch corresp. to advice | Agreed TAC | ICES catch |
|---|---|---|---|---|
| 1987 | TAC | 150 | 115 | 127 |
| 1988 | TAC | 120–150 | 120 | 135 |
| 1989 | TAC | 100 | 100 | 104 |
| 1990 | TAC | 80 | 80 | 86 |
| 1991 | No fishing from a biological point of view | 0 | 76 | 85 |
| 1992 | No fishing from a biological point of view | 0 | 98 | 104 |
| 1993 | No increase in F | 119 | 200 | 232 |
| 1994 | Gradual increase in F towards $F_{0.1}$; TAC suggested | 334 | 450 | 479 |
| 1995 | No increase in F | 513 | 900* | 906 |
| 1996 | Keep SSB above 2.5 million t | - | 1425* | 1220 |
| 1997 | Keep SSB above 2.5 million t | - | 1500 | 1427 |
| 1998 | Do not exceed the harvest control rule | - | 1300 | 1223 |
| 1999 | Do not exceed the harvest control rule | 1263 | 1300 | 1235 |
| 2000 | Do not exceed the harvest control rule | Max 1500 | 1250 | 1207 |
| 2001 | Do not exceed the harvest control rule | 753 | 850 | 766 |
| 2002 | Do not exceed the harvest control rule | 853 | 850 | 808 |
| 2003 | Do not exceed the harvest control rule | 710 | 711* | 790 |
| 2004 | Do not exceed the harvest control rule | 825 | 825* | 794 |
| 2005 | Do not exceed the harvest control rule | 890 | 1000* | 1003 |
| 2006 | Do not exceed the harvest control rule | 732 | 967* | 969 |
| 2007 | Do not exceed the harvest control rule | 1280 | 1280 | 1267 |
| 2008 | Do not exceed the harvest control rule | 1518 | 1518 | 1546 |
| 2009 | Do not exceed the harvest control rule | 1643 | 1642 | 1687 |
| 2010 | Do not exceed the harvest control rule | 1483 | 1483 | 1457 |

| | | | | |
|---|---|---|---|---|
| 2011 | See scenarios | 988–1170 | 988 | 993 |
| 2012 | Follow the management plan | 833 | 833 | 826 |
| 2013 | Follow the management plan | 619 | 692* | 685 |
| 2014 | Follow the management plan | 418 | 436* | 461 |
| 2015 | Follow the management plan | 283 | 328* | 329 |
| 2016 | Follow the management plan | ≤ 316.876 | 377* | |
| 2017 | Follow the management plan | ≤ 646.075 | | |

* There was no agreement on the TAC; the number is the sum of autonomous quotas from the individual Parties.

## History of catch and landings

**Table 9.3.33.8** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Catch distribution by fleet in 2015 as estimated by ICES.

| Total catch (2015) | Landings | | Discards |
|---|---|---|---|
| 328 740 t | 51% purse seine | 49% pelagic trawl | Discarding is considered to be negligible, but some slippage is known to occur. |
| | 328 740 t | | |

**Table 9.3.33.9** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). History of the catch. ICES estimated values are presented by country.

| Year | Norway | USSR/ Russia | Denmark | Faroes | Iceland | Ireland | Nether-lands | Green-land | UK (Scotland) | Germany | France | Poland | Sweden | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 199256 | 26000 | - | - | - | - | - | - | - | - | - | - | - | 225256 |
| 1987 | 108417 | 18889 | - | - | - | - | - | - | - | - | - | - | - | 127306 |
| 1988 | 115076 | 20225 | - | - | - | - | - | - | - | - | - | - | - | 135301 |
| 1989 | 88707 | 15123 | - | - | - | - | - | - | - | - | - | - | - | 103830 |
| 1990 | 74604 | 11807 | - | - | - | - | - | - | - | - | - | - | - | 86411 |
| 1991 | 73683 | 11000 | - | - | - | - | - | - | - | - | - | - | - | 84683 |
| 1992 | 91111 | 13337 | - | - | - | - | - | - | - | - | - | - | - | 104448 |
| 1993 | 199771 | 32645 | - | - | - | - | - | - | - | - | - | - | - | 232457 |
| 1994 | 380771 | 74400 | - | 2911 | 21146 | - | - | - | - | - | - | - | - | 479228 |
| 1995 | 529838 | 101987 | 30577 | 57084 | 174109 | - | 7969 | 2500 | 881 | 556 | - | - | - | 905501 |
| 1996 | 699161 | 119290 | 60681 | 52788 | 164957 | 19541 | 19664 | - | 46131 | 11978 | - | - | 22424 | 1220283 |
| 1997 | 860963 | 168900 | 44292 | 59987 | 220154 | 11179 | 8694 | - | 25149 | 6190 | 1500 | - | 19499 | 1426507 |
| 1998 | 743925 | 124049 | 35519 | 68136 | 197789 | 2437 | 12827 | - | 15971 | 7003 | 605 | - | 14863 | 1223131 |
| 1999 | 740640 | 157328 | 37010 | 55527 | 203381 | 2412 | 5871 | - | 19207 | - | - | - | 14057 | 1235433 |
| 2000 | 713500 | 163261 | 34968 | 68625 | 186035 | 8939 | - | - | 14096 | 3298 | - | - | 14749 | 1207201 |
| 2001 | 495036 | 109054 | 24038 | 34170 | 77693 | 6070 | 6439 | - | 12230 | 1588 | - | - | 9818 | 766136 |
| 2002 | 487233 | 113763 | 18998 | 32302 | 127197 | 1699 | 9392 | - | 3482 | 3017 | - | 1226 | 9486 | 807795 |
| 2003 | 477573 | 122846 | 14144 | 27943 | 117910 | 1400 | 8678 | - | 9214 | 3371 | - | - | 6431 | 789510 |
| 2004 | 477076 | 115876 | 23111 | 42771 | 102787 | 11 | 17369 | - | 1869 | 4810 | 400 | - | 7986 | 794066 |
| 2005 | 580804 | 132099 | 28368 | 65071 | 156467 | - | 21517 | - | - | 17676 | 0 | 561 | 680 | 1003243 |
| 2006* | 567237 | 120836 | 18449 | 63137 | 157474 | 4693 | 11625 | - | 12523 | 9958 | 80 | - | 2946 | 968958 |
| 2007 | 779089 | 162434 | 22911 | 64251 | 173621 | 6411 | 29764 | 4897 | 13244 | 6038 | 0 | 4333 | 0 | 1266993 |
| 2008 | 961603 | 193119 | 31128 | 74261 | 217602 | 7903 | 28155 | 3810 | 19737 | 8338 | 0 | 0 | 0 | 1545656 |
| 2009 | 101667 | 210105 | 32320 | 85098 | 265479 | 10014 | 24021 | 3730 | 25477 | 14452 | 0 | 0 | 0 | 1687371 |
| 2010 | 871113 | 199472 | 26792 | 80281 | 205864 | 8061 | 26695 | 3453 | 24151 | 11133 | 0 | 0 | 0 | 1457015 |
| 2011 | 572641 | 144428 | 26740 | 53271 | 151074 | 5727 | 8348 | 3426 | 14045 | 13296 | 0 | 0 | 0 | 992997 |
| 2012 | 491005 | 118595 | 21754 | 36190 | 120956 | 4813 | 6237 | 1490 | 12310 | 11945 | 0 | 0 | 705 | 826000 |
| 2013 | 359458 | 78521 | 17160 | 10503 | 90729 | 3815 | 5626 | 11788 | 8342 | 4244 | 0 | 0 | 23 | 684743 |
| 2014 | 263253 | 60292 | 12513 | 38529 | 58828 | 706 | 9175 | 13108 | 4233 | 669 | 0 | 0 | 0 | 461306 |
| 2015 | 176321 | 45853 | 9105 | 33031 | 42625 | 1400 | 5255 | 12434 | 55 | 2660 | 0 | 0 | 0 | 328740 |

* In 2006 Scotland and Northern Ireland combined.

## Summary of the assessment

**Table 9.3.33.10** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Assessment summary; weights in tonnes and recruitment in thousands. High and low are 97.5 and 2.5 percentiles, respectively.

| Year | Recruitment age 2 (thousands) | High | Low | Stock size: SSB (tonnes) | High | Low | Catches (tonnes) | Fishing pressure: $F_W$ (5–11) | High | Low |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 642000 | 931000 | 353000 | 2168000 | 2488000 | 1849000 | 135301 | 0.04 | 0.059 | 0.022 |
| 1989 | 1159000 | 1620000 | 698000 | 3352000 | 3847000 | 2858000 | 103830 | 0.032 | 0.047 | 0.017 |
| 1990 | 4290000 | 5365000 | 3216000 | 3631000 | 4156000 | 3107000 | 86411 | 0.029 | 0.043 | 0.015 |
| 1991 | 11374000 | 13483000 | 9266000 | 3401000 | 3891000 | 2912000 | 84683 | 0.03 | 0.044 | 0.016 |
| 1992 | 18302000 | 21301000 | 15304000 | 3425000 | 3892000 | 2958000 | 104448 | 0.037 | 0.053 | 0.02 |
| 1993 | 48971000 | 55207000 | 42735000 | 3388000 | 3806000 | 2969000 | 232457 | 0.075 | 0.101 | 0.048 |
| 1994 | 59085000 | 66113000 | 52058000 | 3511000 | 3927000 | 3096000 | 479228 | 0.126 | 0.162 | 0.09 |
| 1995 | 15409000 | 17980000 | 12837000 | 3561000 | 3959000 | 3164000 | 905501 | 0.181 | 0.228 | 0.135 |
| 1996 | 5587000 | 6766000 | 4409000 | 4082000 | 4479000 | 3685000 | 1220283 | 0.168 | 0.204 | 0.132 |
| 1997 | 2064000 | 2620000 | 1508000 | 5287000 | 5761000 | 4813000 | 1426507 | 0.187 | 0.221 | 0.152 |
| 1998 | 10605000 | 12519000 | 8692000 | 5818000 | 6340000 | 5296000 | 1223131 | 0.186 | 0.222 | 0.15 |
| 1999 | 6409000 | 7712000 | 5105000 | 5681000 | 6226000 | 5137000 | 1235433 | 0.207 | 0.247 | 0.166 |
| 2000 | 33151000 | 37771000 | 28530000 | 4733000 | 5231000 | 4236000 | 1207201 | 0.248 | 0.298 | 0.199 |
| 2001 | 29265000 | 33530000 | 25001000 | 3940000 | 4386000 | 3494000 | 766136 | 0.201 | 0.245 | 0.158 |
| 2002 | 11709000 | 13870000 | 9547000 | 3491000 | 3907000 | 3076000 | 807795 | 0.224 | 0.272 | 0.175 |
| 2003 | 6779000 | 8204000 | 5355000 | 4157000 | 4629000 | 3686000 | 789510 | 0.14 | 0.171 | 0.109 |
| 2004 | 59565000 | 67485000 | 51644000 | 5292000 | 5875000 | 4709000 | 794066 | 0.102 | 0.127 | 0.078 |
| 2005 | 25164000 | 29333000 | 20995000 | 5447000 | 6066000 | 4828000 | 1003243 | 0.145 | 0.18 | 0.111 |
| 2006 | 45195000 | 52304000 | 38086000 | 5461000 | 6085000 | 4837000 | 968958 | 0.156 | 0.194 | 0.118 |
| 2007 | 11958000 | 14459000 | 9456000 | 7092000 | 7890000 | 6294000 | 1266993 | 0.147 | 0.18 | 0.115 |
| 2008 | 16558000 | 20080000 | 13036000 | 7235000 | 8101000 | 6368000 | 1545656 | 0.193 | 0.235 | 0.15 |
| 2009 | 6847000 | 8706000 | 4988000 | 7263000 | 8218000 | 6307000 | 1687373 | 0.196 | 0.238 | 0.154 |
| 2010 | 4389000 | 5796000 | 2982000 | 6458000 | 7416000 | 5501000 | 1457014 | 0.196 | 0.241 | 0.15 |
| 2011 | 20181000 | 25726000 | 14635000 | 6068000 | 7067000 | 5070000 | 992998 | 0.147 | 0.183 | 0.11 |
| 2012 | 5419000 | 7484000 | 3353000 | 5874000 | 6910000 | 4838000 | 825999 | 0.133 | 0.167 | 0.099 |
| 2013 | 9185000 | 12853000 | 5517000 | 5571000 | 6591000 | 4550000 | 684743 | 0.118 | 0.15 | 0.087 |
| 2014 | 5967000 | 9209000 | 2724000 | 5496000 | 6545000 | 4447000 | 461306 | 0.078 | 0.1 | 0.056 |
| 2015 | 14748000 | 24120000 | 5376000 | 5264000 | 6302000 | 4227000 | 328740 | 0.06 | 0.078 | 0.041 |
| 2016 | 13015000* | 29483000 | 0** | 5023000 | 6024000 | 4023000 | | | | |
| **Average** | **17344552** | **21104483** | **13703655** | **4867931** | **5517759** | **4218448** | **815177** | **0.135** | **0.167** | **0.103** |

*Estimated by XSAM.

**Approximately lower 2.5 percentiles.

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