FISH PASSAGE CENTER

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MEMORANDUM

TO: Paul Wagner, NMFS

FROM: Michele DeHart

DATE: April 20, 2000

RE: Fish Passage Index Data

In response to your memorandum dated April 19, 2000 (attached) we have prepared the following response. Your memorandum included three different requests. We have addressed each one. Each request included a sparse description of the anticipated use and management application of the data summary requested. We address the appropriate application of the data in the response to each objective. A clear understanding of the data is required to avoid misuse of the data and subsequent controversy among the parties.

The use of the cumulative passage plot by the salmon managers is based upon the fact that it addresses the objectives of BIOP measure implementation, which is the protection of the largest part of the migration without disadvantage to weak stocks. The cumulative passage plots are useful for assessing the progress of passage at particular sites, but flow management recommendations by the Salmon Managers incorporate specific stock passage travel time. We question whether or not the flow management objectives described by the federal parties reflect the intent of the NMFS BIOP flow measures. Flow targets were not intended to benefit a particular component of passage, specifically not peak passage. We also question the utility of these predictions since flow management to date is primarily driven by the hard constraints in the Opinion, which are reservoir elevation targets.

The General Objective

Overall, after considering and discussing the requests and objectives by the federal operating agencies, it appears that the intended purpose of these data representations is to predict peak passage and/or passage timing. The purpose appears to be to manage flows on a shorter than seasonal basis or by the planning dates defined in the Biological Opinion. This appears to be a means of managing flows within the planning dates, or spill-planning dates included in the NMFS Biological Opinion. The federal parties appear to be searching for criteria beyond the Biological Opinion parameters, which would allow flows to be managed to provide flows for peak passage periods and potentially provide lower flows at either side of the peak period. This

management strategy is not included in the Biological Opinion. It has in fact been specifically rejected within the Opinion, which is designed to protect weak stocks, which by definition are those, which have low population numbers and therefore would reflect low passage numbers. The strategies being pursued by the operators would tend to provide less protection to weaker stocks, earlier and later stocks. The attached plot of passage at John Day shows that even the present NMFS planning dates to not provide equal protection to all components of the run at large.

To date, the management of spill and flow within the confines of the NMFS Biological Opinion planning date parameters has been the purview of the state, federal and tribal fishery managers. To this end it is important to consider the basis used by the fishery managers in developing flow requests, particularly the appropriate use of the passage index. The cumulative passage plots have been useful in considering flow management options according to the planning dates of the Opinion.

The federal concept of providing less flow for lower passage periods is flawed and unacceptable because:

- Specific stock timing varies widely; the approach contemplated by the federal parties will provide less protection to earlier and later migrating stocks.
- Flow management as contemplated by the federal parties will reduce protection to weak stocks, such as wild stocks, that are present in low numbers, when they are present in the river at other than peak periods.
- Passage timing and the passage index respond to provision of flow level increasing or decreasing flow changes the passage index.
- Prudent management of weak stocks and the protection of biological diversity does not support the management of flows contemplated by the federal parties. The approach reflected in the Biological Opinion is intended to provide protection to a wide scope of stocks. Even the Biological Opinion planning dates do not encompass all of the stocks equally.
- The passage index and all passage data reflect the natural and artificial production in a particular year. The passage timing and passage index can change dramatically according to changes in artificial and natural production. At the present time, artificial production programs in some areas are undergoing a significant change and this will continue as a result of the Artificial Production Review. This will undoubtedly be reflected in the passage index.

Passage index data

The daily passage index provides a relative number of the fish passing a particular dam during a 24-hr period. It is not an estimate of the absolute number of fish passing during that period. It is computed by dividing the daily collection by the proportion of flow passing through the powerhouse where sampling takes place. It assumes fish enter the powerhouse in the same proportion as flow passes through that route (1:1 spill effectiveness). It does not take into account the fish guidance efficiency of the screens or changes in spill efficiency. The distribution of these passage indices over a season for a given fish species provides a relative distribution of passage timing. Sharp changes in the magnitude of the daily passage indices for a species are reflected when large increases or decreases are occurring in the run at a particular dam. The sum of daily passage indices over a season for a given species and at a particular dam provides a <u>relative</u> measure of that year's run strength.

It is extremely important to realize that the passage index responds to changes in flow and or other project operations. If flow is decreased, the passage index will decrease and the subsequent timing of stocks will be protracted or truncated if the flow decrease is large enough to essentially stop the downstream migration. If flow increases significantly, the passage index will also change, daily numbers increase, timing can be shifted forward and total seasonal passage numbers can increase. All of the requests by the federal operators appear to be aimed at the management of flow, either by predicting a percentage of the run passed or by targeting the largest part of the migration, based on the passage index. This approach is designed to base a flow management decision, deciding on a level of flow for a particular time period, on criteria that is affected by flow. The criteria for management are not independent of the management decisions.

In addition, the passage index at a particular project cannot be considered in terms of flow management without considering the projected travel time of fish through the downstream reach to below Bonneville at a particular flow level. For example, consideration of peak passage at any particular site does not account for the travel time or downstream distribution of those fish through the downstream reach. Decreasing flows, based on the fact that fish had passed that site and would not pass again, would only have the affect of stranding them in the downstream reach. Managing flows for a peak passage period at any particular site is not justified and not useful.

Present Cumulative passage plots

The cumulative passage plots provide a picture of the relative migration timing of the current year to an average of prior years. The shape of the historic cumulative curve is based on averaging a given day's proportion of the season across a series of years. Both a given day's average proportion and the variance of this average are computed for every day of the season. The sum of the average proportions and sum of the variances are used in computing the historic cumulative curve and approximate 95% confidence intervals. A scaling of the historic cumulative average proportions [formerly, a 0 to 1 scale] and its respective confidence intervals is made to transform the curves to the scale of the current year's projected cumulative passage index. When available, the scalers utilize the NMFS projected population sizes and facility collection efficiencies assumed in providing fish quotas for ESA permitting. Otherwise, the scalers utilize the cumulative passage indices of a single year or average of a series of contiguous years. The utility of the cumulative passage plots is with regards to the passage timing of the fish, and not in whether the current year's final value is higher or lower than the historic years. The choice of this way of presenting the data is based on the need to relate a current year's passage progress to a historic base in-season, rather than waiting until the season is completed to present the current year's cumulative passage data on a 0 to 1 scale. The cumulative passage presentation is only one tool in the fishery manager's consideration of flow management decisions. Passages index data cannot and are not used independently of other data by the salmon managers when they develop flow and passage recommendations.

The cumulative passage plots are utilized to ascertain, during the migration season, the beginning and end of the migration relative to the NMFS BIOP planning dates. However, the shape of the cumulative passage plots is affected by the provision of flows and the BIOP planning dates.

Purpose- predicting the peak of passage to adjust flow levels once the peak has passed, (BPA)

Robyn Mackay expressed the view that if the data were presented in the form of a normal frequency distribution it would be a more familiar style of presentation and easier to grasp. It may also show that if the expected peak of migrants passed early you could change your flow management strategy to reflect that fact, since you would not expect them to pass again.

The passage index data may be presented in any format and any style of graph. However, the style of graph does not change what the data actually represents. The key phrase in the BPA objective is "not expected to pass again". The question is what do you expect to pass? What is the peak number going to be? In order to utilize the data as anticipated by BPA, it would be necessary to <u>know with certainty</u> the total passage index in advance of the end of the passage season. A total passage number cannot be estimated prior to or during the passage season with accuracy because of the difficulty in predicted wild production, and survival of artificial production releases and the affect of flow on the passage index. Peaks and valleys in daily passage plots will be caused by flow fluctuations. Many days of low passage indices may total a large proportion of the total passage when the days are considered cumulatively. Since flow is provided for travel time through the entire reach, predicted travel time at particular flows through the entire reach need to be considered in flow management relative to passage at any site. In addition, changes in one or more production program can affect the passage index at any particular site from year to year. Over wintering conditions can also affect the out-migration pattern of fish and therefore the passage pattern. Seeing a peak occur does not predict subsequent passage patterns. The cumulative passage plot is actually more useful for the stated BPA purpose, as long as the line is continuing with a slope.

An interactive query is included in the FPC home page, which updates daily by species the passage index in a daily line graph. This data is available in graph or tabular form on the FPC web page in this format for 1985 through 2000, with the 2000 daily indices updated daily. This can be printed from the page. Examples attached. The format requested by Robyn is already available from the web page.

Purpose – To predict peak passage for flow management

Predicting passage based on past years timing utilizing probability curves based on historic passage data.

Jim Litchfield, State of Montana, expressed a desire to see probability distributions displayed on the graph based on the ten-year average passage timing and the existing year's run plotted relative to that 10-year average.

The cumulative passage plots as presently shown, essentially display the ten-year average passage distribution against the passage that occurred to date. However it is not utilized as a predictor as much as a relative indicator of passage. We have modified the display of the cumulative average passage to a histogram form. We have also displayed each year of passage index in a histogram form (attached). This illustrates the wide variation in peak passage timing and magnitude that occurs from year to year. We have illustrated that it is certainly possible to take the last ten years of passage data and present it as the ten-year average passage timing. However, because each year's annual passage is comprised of several peaks and valleys (see graph) plotting a graph in the fashion described would be misleading because the actual passage responds to many variables. Most of the discussion that has been associated with the use of cumulative passage curves in past years has been because of the desire on the part of the Action

Agencies to manage flows for the peaks of the run. Regardless of the form of the data presentation, whether in a cumulative line or a histogram, the data is the same and the limitations are the same. In each case only a relative indication of passage is possible. A prediction of proportion of passage is dependent on an accurate prediction of total passage. In any data presentation format prediction of passage to date will have a very wide error band, which will essentially preclude its use determining weekly flow levels for passage.

NMFS Biological Opinion measures are intended to protect listed ESA stocks of yearling chinook and steelhead, sockeye, and sub-yearling chinook. By nature of their low numbers, the listed fish are masked by the larger numbers of unlisted hatchery fish that dominate the run-at-large. Plotting distributions to pick out periods of peak passage of the run at large at dams is inappropriate for modifying management decisions in-season because of the stock-by-stock variation in timing and magnitude and the variation caused by flow, spill, and other factors year to year.

Purpose – To display peak passage periods in season relative to flow in season.

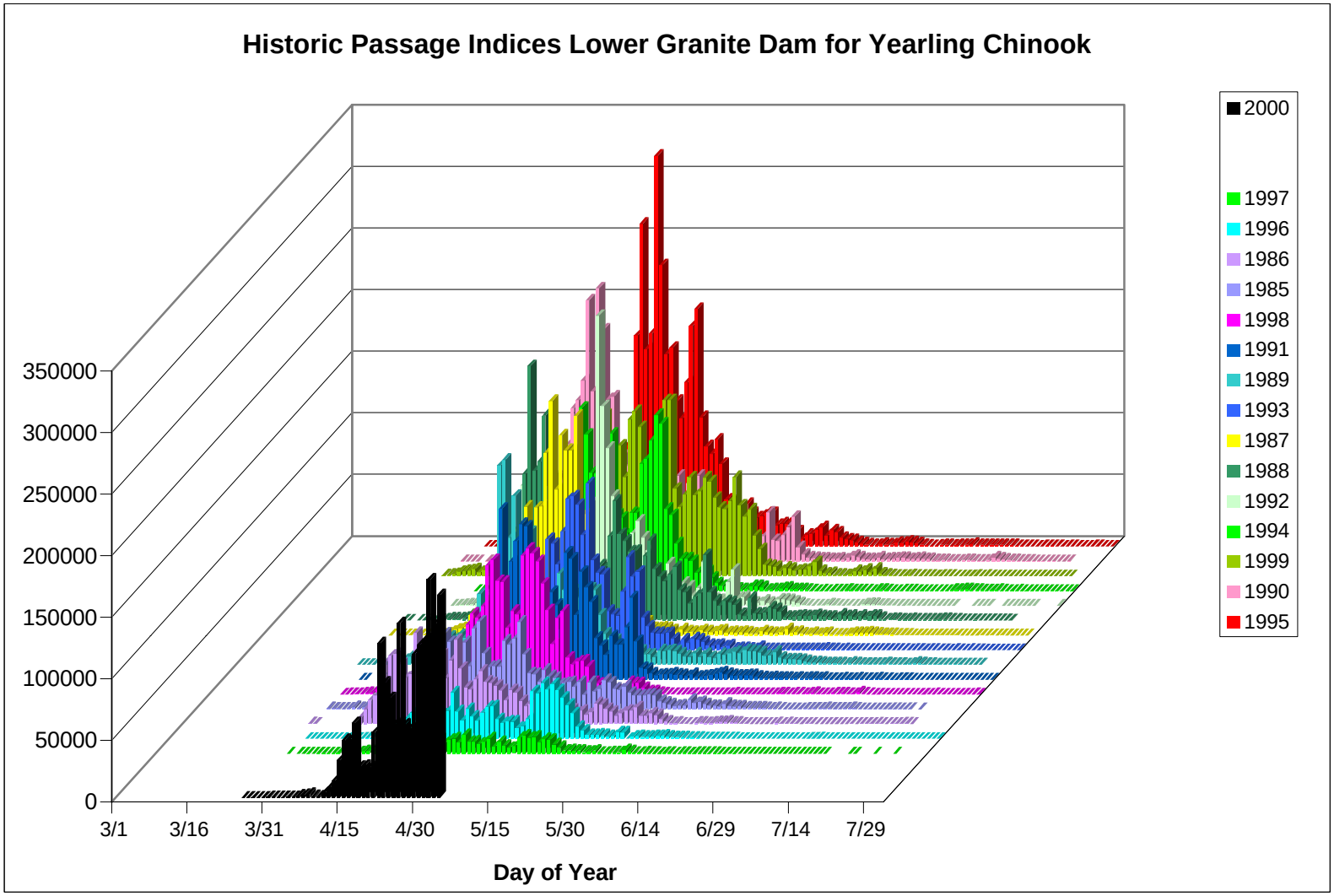
Cindy Henricksen, Corps of Engineers, expressed the desire to see the data presented in-season in the manner it is displayed at the end of the season. Chris Ross usually does a presentation in which fish passage and flow are overlaid. This shows when the peak or peaks of the run occurs within the season relative to river conditions.

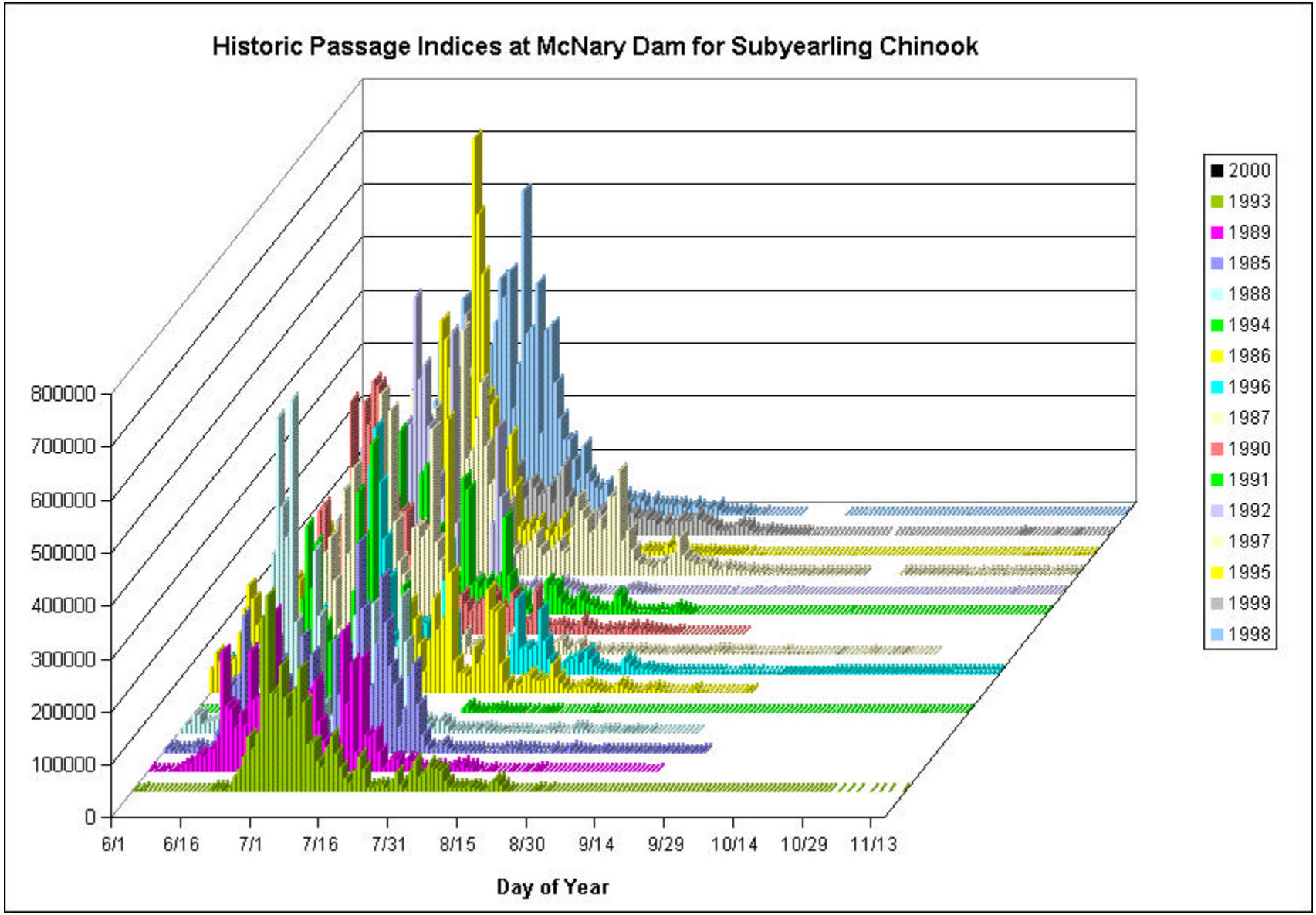
The data requested is already provided in the form requested on the FPC web page. Data for 2000 by species and site is updated daily and can be accessed through an interactive query in which the site, and species is selected, the flow and passage index is then graphed. This graph can be printed out. It is available 24 hours a day at www.fpc.org/PI_Detail.html. Examples of those graphs are attached.

The Fish Passage Center has developed a 3-dimensional graph where the historic passage indices are plotted along with the current passage index. As can be seen from these graphs, each annual migration displays a distinct pattern of passage that is often related to factors outside of our control (hatchery release schedules, temperature, turbidity) and factors within our control (project operations, flow). For this reason, it is not appropriate to collapse that variability into a smooth probability distribution by summarizing the data. We do find these graphs extremely useful in depicting the variability of the data collected annually.

In summary, we believe that the best representation of the annual information compared to historic data, remains the cumulative passage plots. This is because it best displays the overall passage pattern relative to the manner in which the NMFS Opinion measures are provided, within seasonal planning dates. The ability to predict proportion of fish passed based on historical data is extremely limited with wide error bands. This is because the passage index responds to flow and other operations decisions as well as other variables.

122-00.doc


Historic Passage Indices Lower Granite Dam for Yearling Chinook
350000
300000
250000
200000
150000
100000
50000
0
3/1
3/16
3/31
4/15
4/30
5/15
5/30
6/14
6/29
7/14
7/29
Day of Year
2000
1997
1996
1986
1985
1998
1991
1989
1993
1987
1988
1992
1994
1999
1990
1995


Historic Passage Indices at McNary Dam for Subyearling Chinook
800000
700000
600000
500000
400000
300000
200000
100000
0
6/1
6/16
7/1
7/16
7/31
8/15
8/30
9/14
9/29
10/14
10/29
11/13
Day of Year
2000
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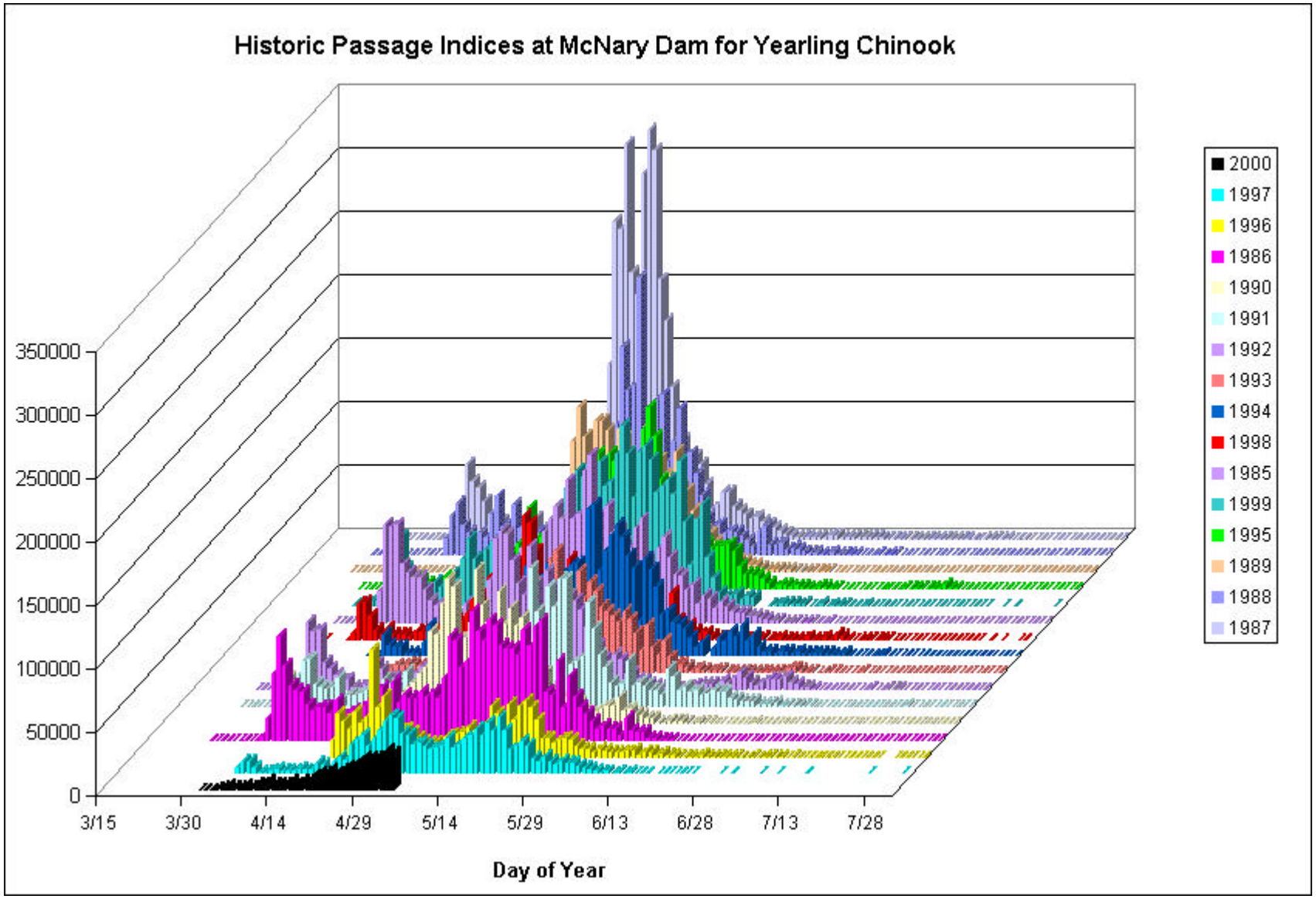
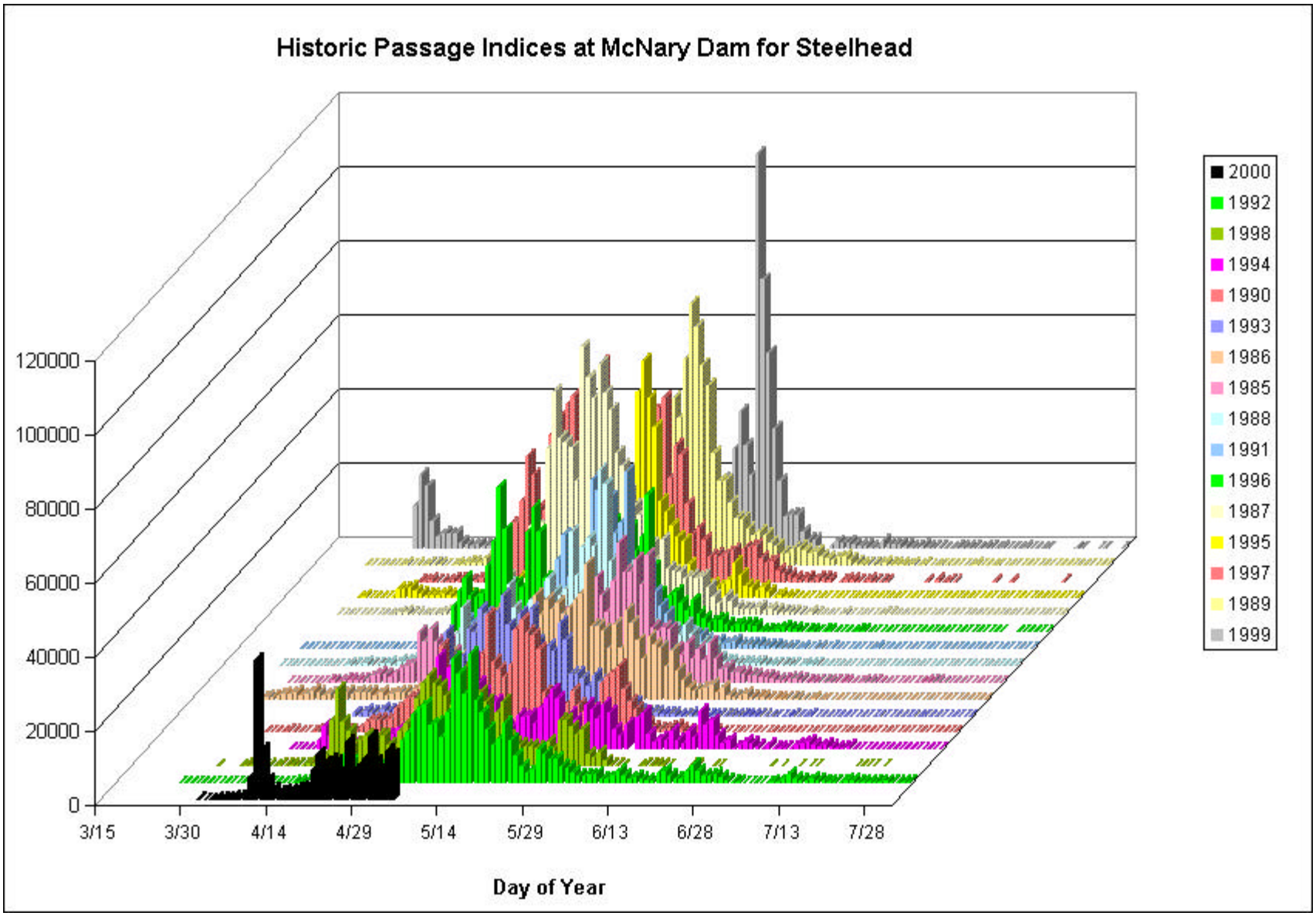
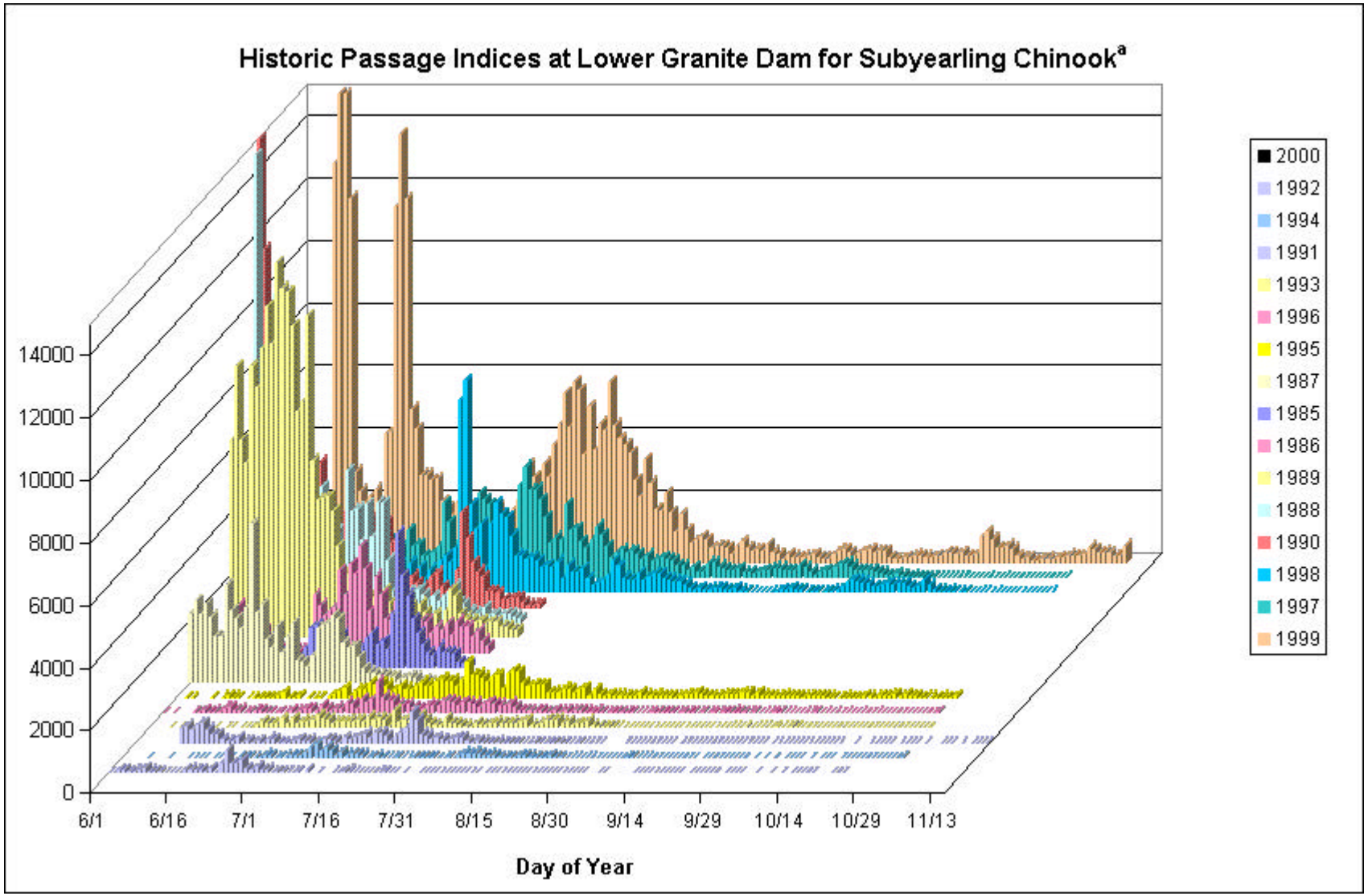
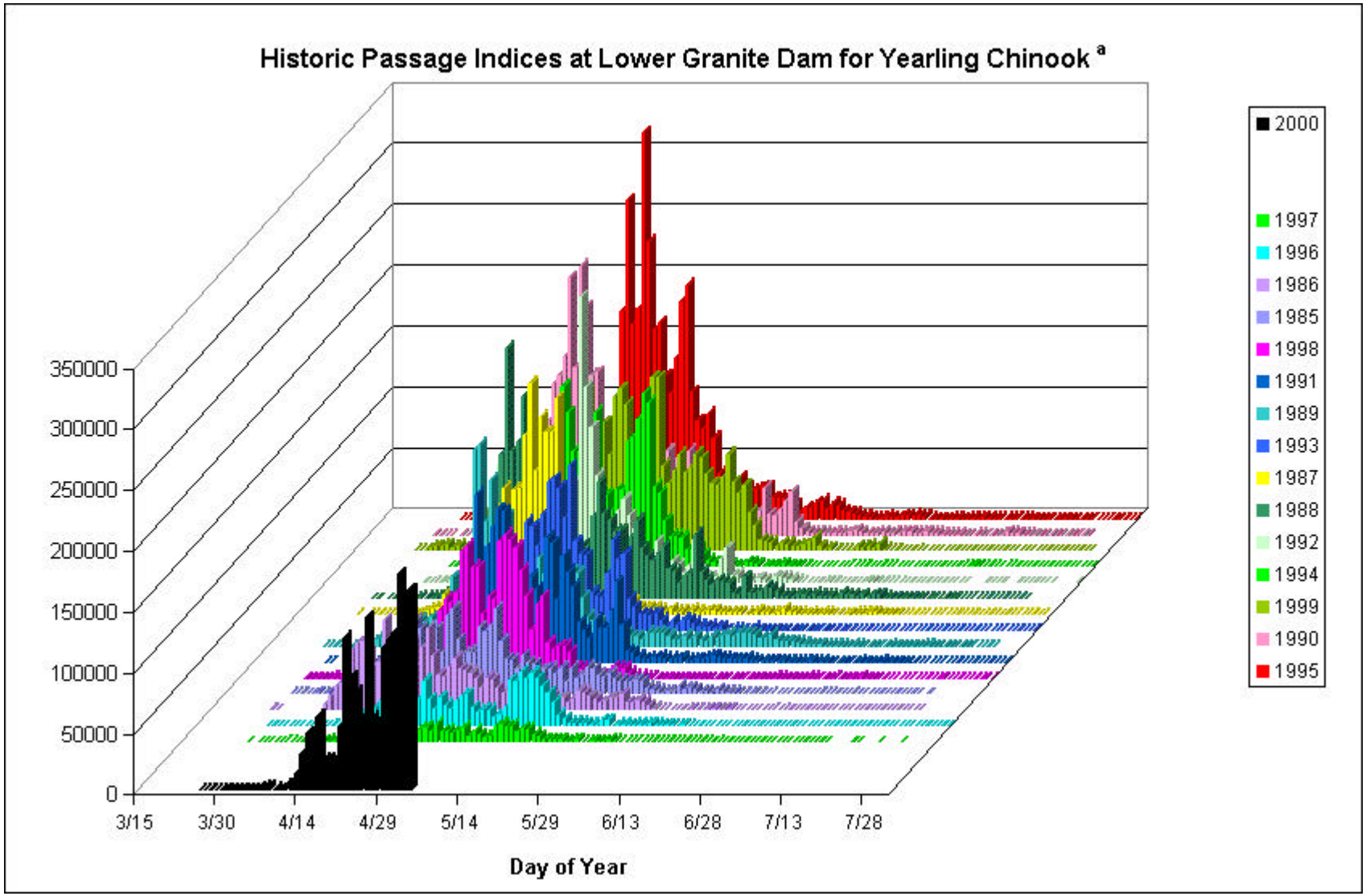
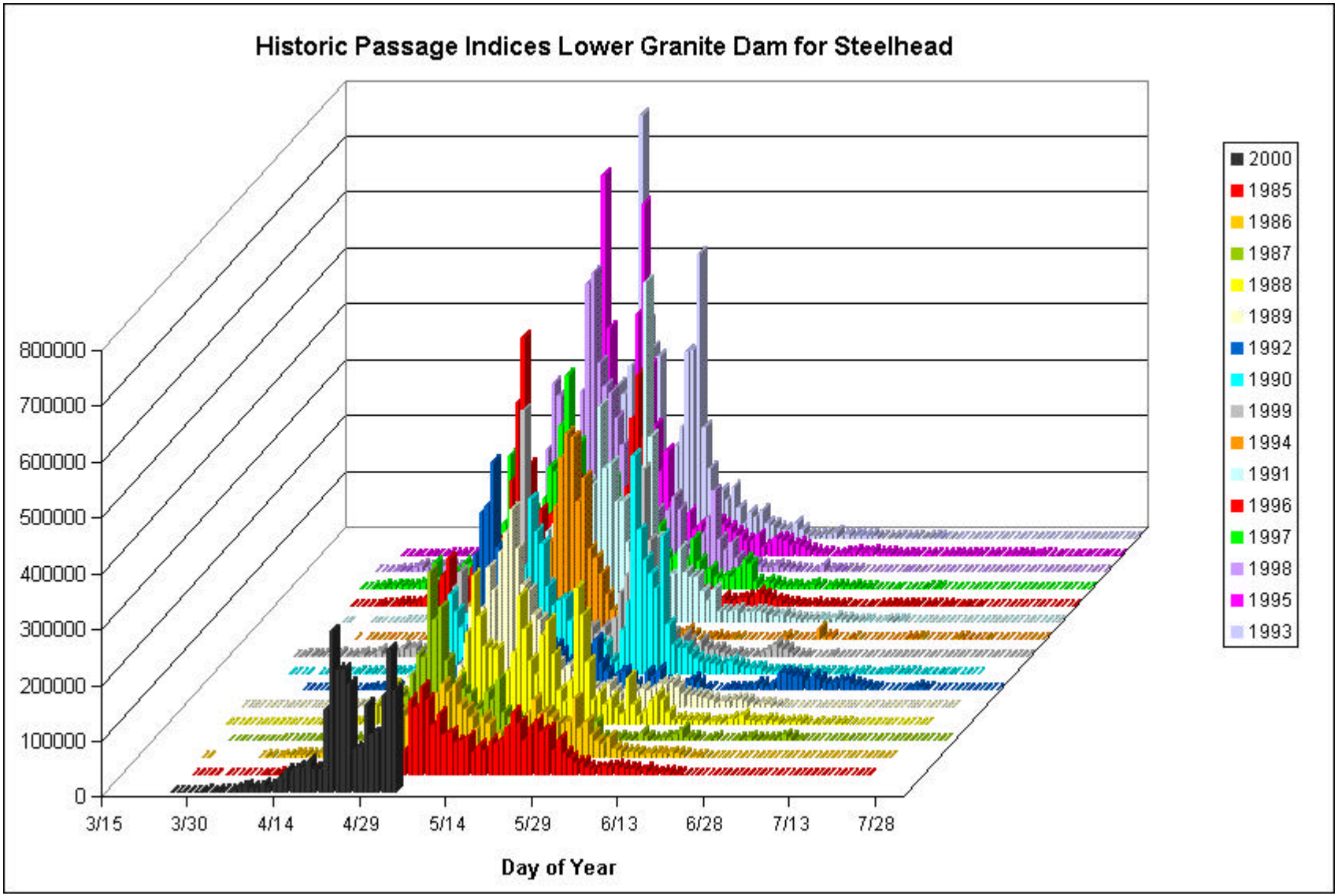
1991
1992
1997
1995
1999
1998

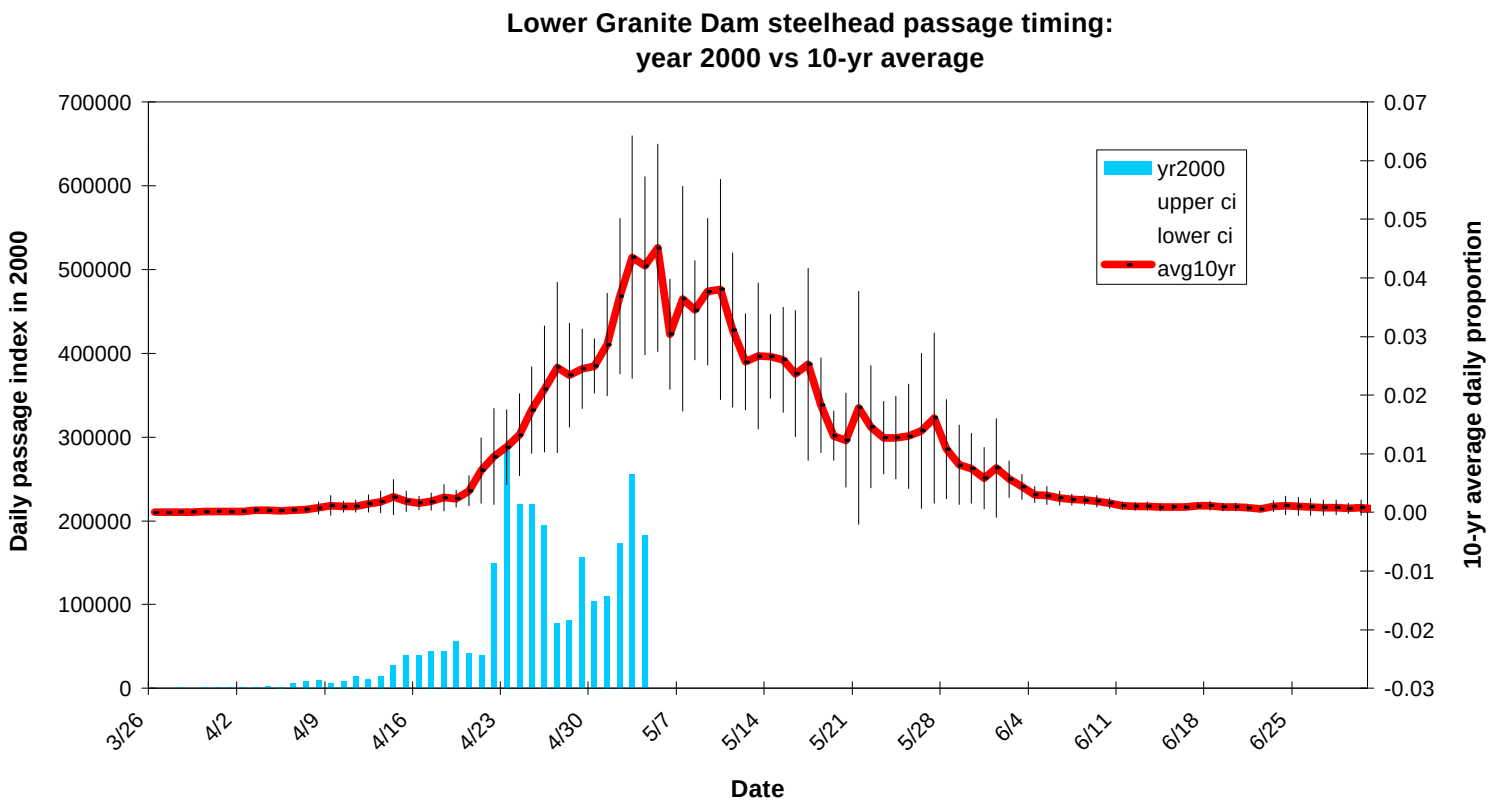

Historic Passage Indices at McNary Dam for Yearling Chinook
350000
300000
250000
200000
150000
100000
50000
0
3/15
3/30
4/14
4/29
5/14
5/29
6/13
6/28
7/13
7/28
Day of Year
2000
1997
1996
1986
1990
1991
1992
1993
1994
1998
1985
1999
1995
1989
1988
1987

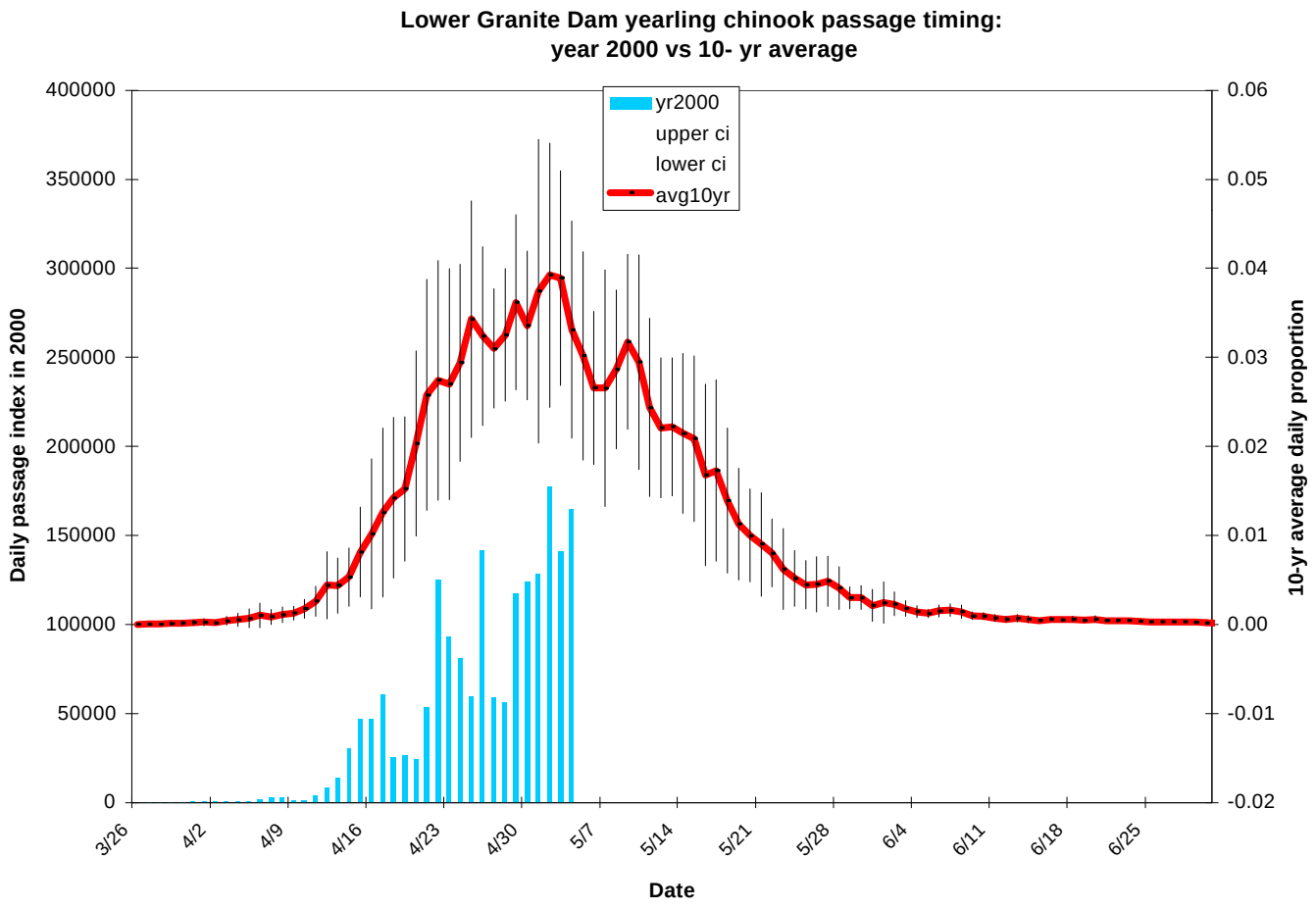

Historic Passage Indices at McNary Dam for Steelhead
120000
100000
80000
60000
40000
20000
0
3/15
3/30
4/14
4/29
5/14
5/29
6/13
6/28
7/13
7/28
Day of Year
2000
1992
1998
1994
1990
1993
1986
1985
1988
1991
1996
1987
1995
1997
1989
1999


Historic Passage Indices at Lower Granite Dam for Subyearling Chinook[a]
14000
12000
10000
8000
6000
4000
2000
0
6/1
6/16
7/1
7/16
7/31
8/15
8/30
9/14
9/29
10/14
10/29
11/13
Day of Year
2000
1992
1994
1991
1993
1996
1995
1987
1985
1986
1989
1988
1990
1998
1997
1999


Historic Passage Indices at Lower Granite Dam for Yearling Chinook a
350000
300000
250000
200000
150000
100000
50000
0
3/15
3/30
4/14
4/29
5/14
5/29
6/13
6/28
7/13
7/28
Day of Year
2000
1997
1996
1986
1985
1998
1991
1989
1993
1987
1988
1992
1994
1999
1990
1995


Historic Passage Indices Lower Granite Dam for Steelhead
800000
700000
600000
500000
400000
300000
200000
100000
0
3/15
3/30
4/14
4/29
5/14
5/29
6/13
6/28
7/13
7/28
Day of Year
2000
1985
1986
1987
1988
1989
1992
1990
1999
1994
1991
1996
1997
1998
1995
1993


Lower Granite Dam steelhead passage timing:
year 2000 vs 10-yr average
Daily passage index in 2000
10-yr average daily proportion
Date
yr2000
upper ci
lower ci
avg10yr
700000
600000
500000
400000
300000
200000
100000
0
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
3/26
4/2
4/9
4/16
4/23
4/30
5/7
5/14
5/21
5/28
6/4
6/11
6/18
6/25


Lower Granite Dam yearling chinook passage timing:
year 2000 vs 10- yr average
yr2000
upper ci
lower ci
avg10yr
Daily passage index in 2000
10-yr average daily proportion
Date
400000
350000
300000
250000
200000
150000
100000
50000
0
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
3/26
4/2
4/9
4/16
4/23
4/30
5/7
5/14
5/21
5/28
6/4
6/11
6/18
6/25