Humpback Chub Tributary Translocation Monitoring

GRAND CANYON · NATIVE FISH

ECOLOGY AND CONSERVATION

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NATIONAL PARK SERVICE

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Fish illustrations by Joe Tomelleri

Today

- Why translocate?
- Shinumo Creek
- Havasu Creek
- Bright Angel Creek
- Come join us!

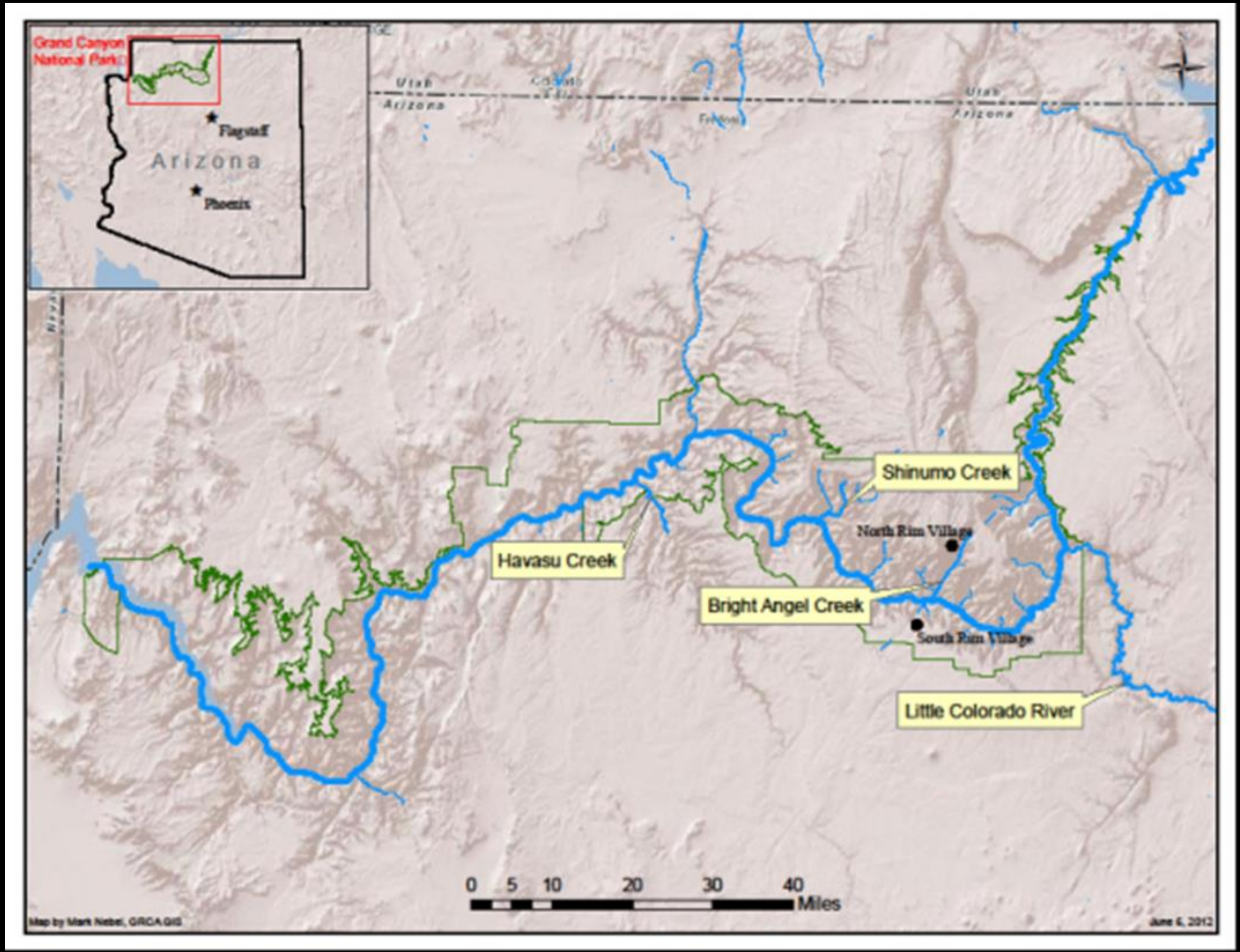
Translocation Objectives & Indicators

Why translocate?

Success measured by 1) the establishment of a second spawning & recruiting population or 2) sufficient survival and growth to provide a rearing opportunity to augment the local aggregation (CFMP 2013)

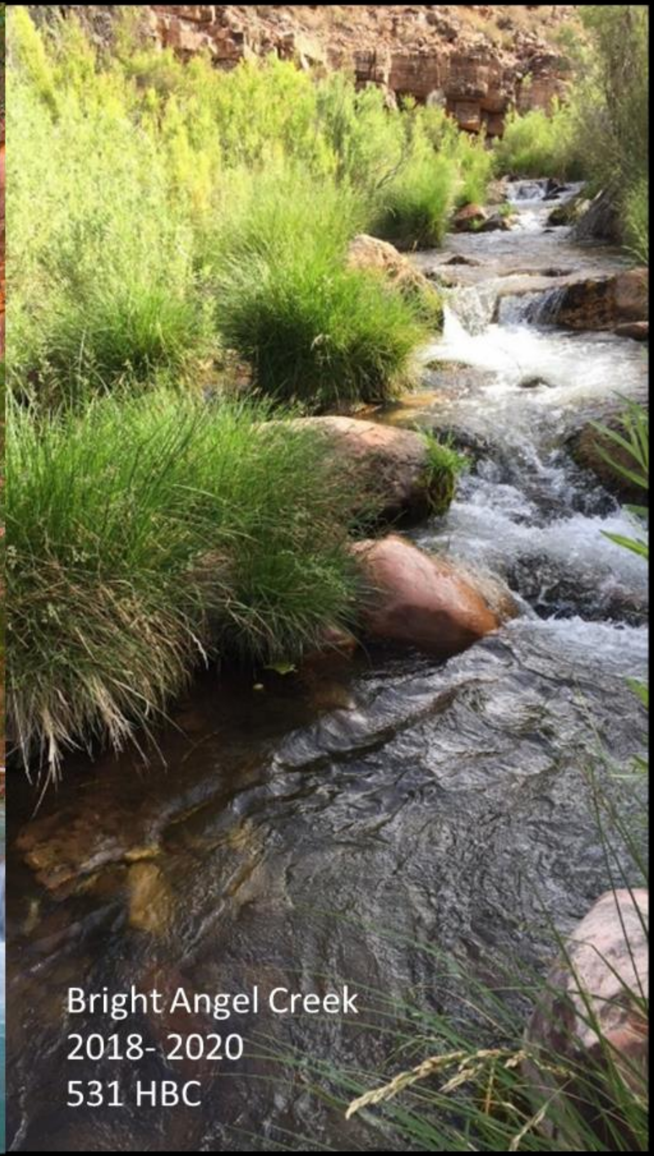
Evaluation of success: (*a*) retention in the translocation creek for a minimum of one year, (*b*) similar or increased survival of juveniles relative to survival in the LCR or Colorado River, (*c*) similar or increased growth rates relative to the LCR and mainstem, (*d*) contributions to the mainstem aggregation, (*e*) evidence of successful reproduction, (*f*) evidence of recruitment to maturity (Trammell et al. 2012, NPS-CFMP 2013).

Project Area



The project area, including the Little Colorado River which is the source for collections of humpback chub for translocations, and translocation sites including Shinumo Creek, and Bright Angel Creek, Havasu Creek in Grand Canyon National Park (green boundaries).

Translocations outside of the Little Colorado River



Translocation-related field work, FY 2021

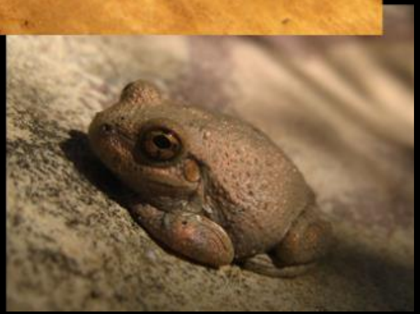
Five monitoring trips: on the Colorado River in the Shinumo Inflow reach (1 trip); in the Colorado River inflows around Bright Angel Creek, Shinumo Creek, and Havasu Creek (1); in Bright Angel Creek (1), and in Havasu Creek (2).

One targeted winter invasive trout control trip was implemented at suspected sources of trout production in tributaries and tributary mouths along the Colorado River between Nankoweap Creek and Surprise Creek. A total of 111 rainbow trout and 19 brown trout were captured during this trip.

Surveillance for potential invasive species

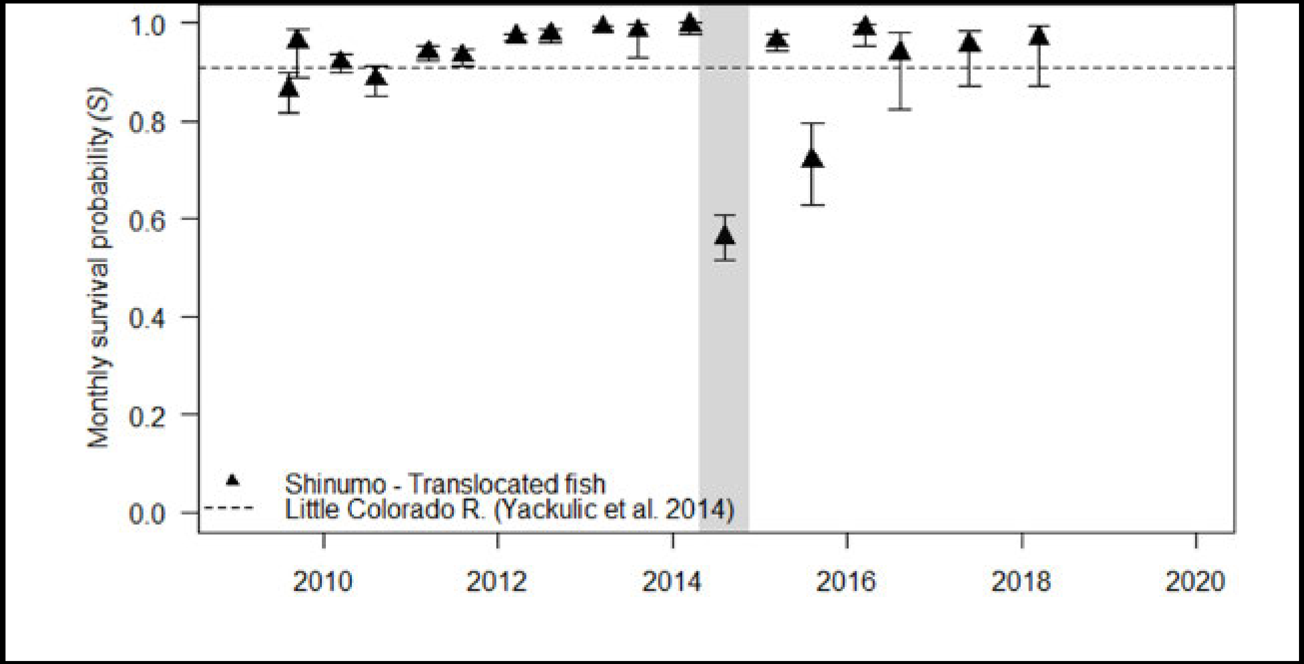
Seine nets were used for presence/ absence surveillance of potential invasive species in hotspots including Kanab and Surprise creeks and large backwaters during June and September mainstem translocation monitoring trips. During these efforts, invasive green sunfish, plains killifish, and fathead minnows were captured along with native fish species.

Shinumo Creek



Shinumo Creek 2014 Galahad Fire & Flooding

Shinumo Creek Survival



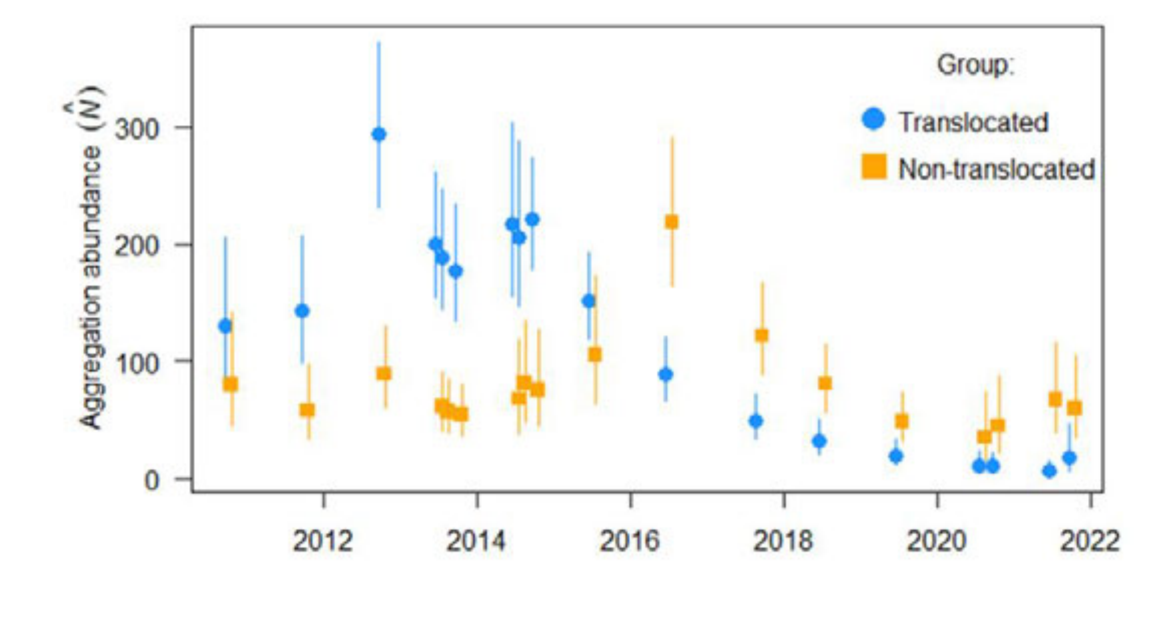
Survival (accounting for site fidelity) estimates over time for translocated HBC relative to survival in the LCR (dashed line; Yackulic et al. 2014). Triangles indicate survival estimates for each interval between sampling events, and the dashed reference line is a survival benchmark for the LCR for comparison to Shinumo HBC survival (standardized to a monthly rate). The gray vertical bar indicates the timing of the Galahad Fire and subsequent ash-laden flood that occurred in July 2014. Source: Healy et al. (*in review*).

A joint-live recapture/resight model "Barker's model"- estimate survival for HBC translocated to SHI (using data collected by NPS, AZGFD, GCMRC, and USFWS in Shinumo Creek, the Little Colorado River, and the mainstem Colorado River; Healy et al. *in review*).

Survival was comparable to that in the LCR (Yackulic et al. 2014) except for the intervals following the Galahad Fire and subsequent ash-laden flood that apparently led to high mortality of translocated HBC (Healy et al. *in review*).

No recent estimates of survival due to low numbers of resights.

Shinumo Creek- Contribution to Inflow aggregation



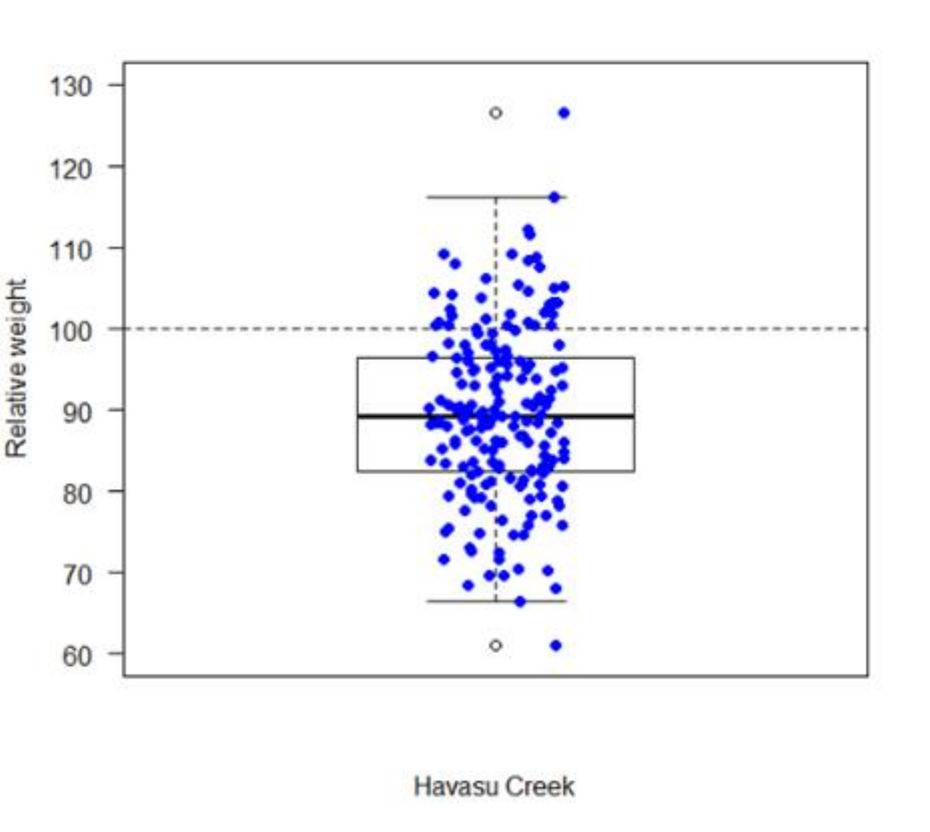
Results of POPAN mark-recapture modeling showing differences in proportional abundance of non-translocated HBC and those translocated to SHI (2009 – 2014) to the SHI Inflow aggregation (between RM 108.3 and 109.5).

POPAN parameter estimates include the probability of entry of individuals into the population through births or immigration during each sampling occasions (recruitment), apparent survival (ϕ), abundance on each occasion ($\hat{N}$), and a super-population abundance (N*). N* is defined as the total number of individuals estimated during the entire study period (Schwarz and Arnason 1996).

- The proportional contribution of translocated fish to the SHI aggregation was generally higher than non-translocated fish through 2014
- A higher proportion of non-translocated fish entered the population in 2015-2016
- Both groups' abundance declined after 2016.
- Cautious with absolute abundance estimates due to variation in sampling effort over time, but:
  - Relative *contributions* of groups to the aggregation abundance at a given time and to the super population should be considered more reliable.
  - Abundance estimates for the non-translocated group are within a range estimated by Valdez and Ryel 1995 & Persons et al. 2017. GCMRC/FWS CPUE results also showed increases in HBC in the area following translocations (Persons et al. 2017)


Havasu Creek

Havasu Creek Body Condition

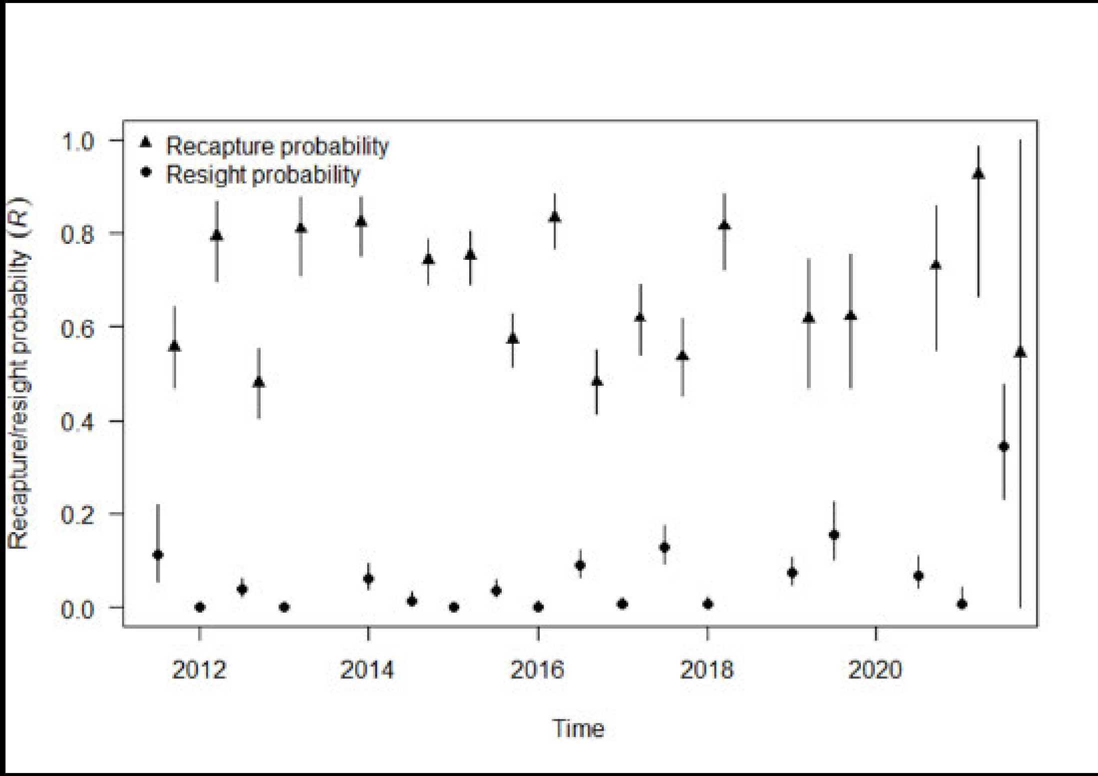


The mean relative weight of May 2021 Havasu HBC (>120 mm) was 89.48 (95% C.I. = 78.92 – 100.04). Median relative weights were slightly lower than the established standard (i.e., <100) but similar to past years (median range: 79.5 – 103.7, 2011 – 2019)

Estimates lower than the standard may relate to HBC density and lack of flooding (Healy et al. *in review*).

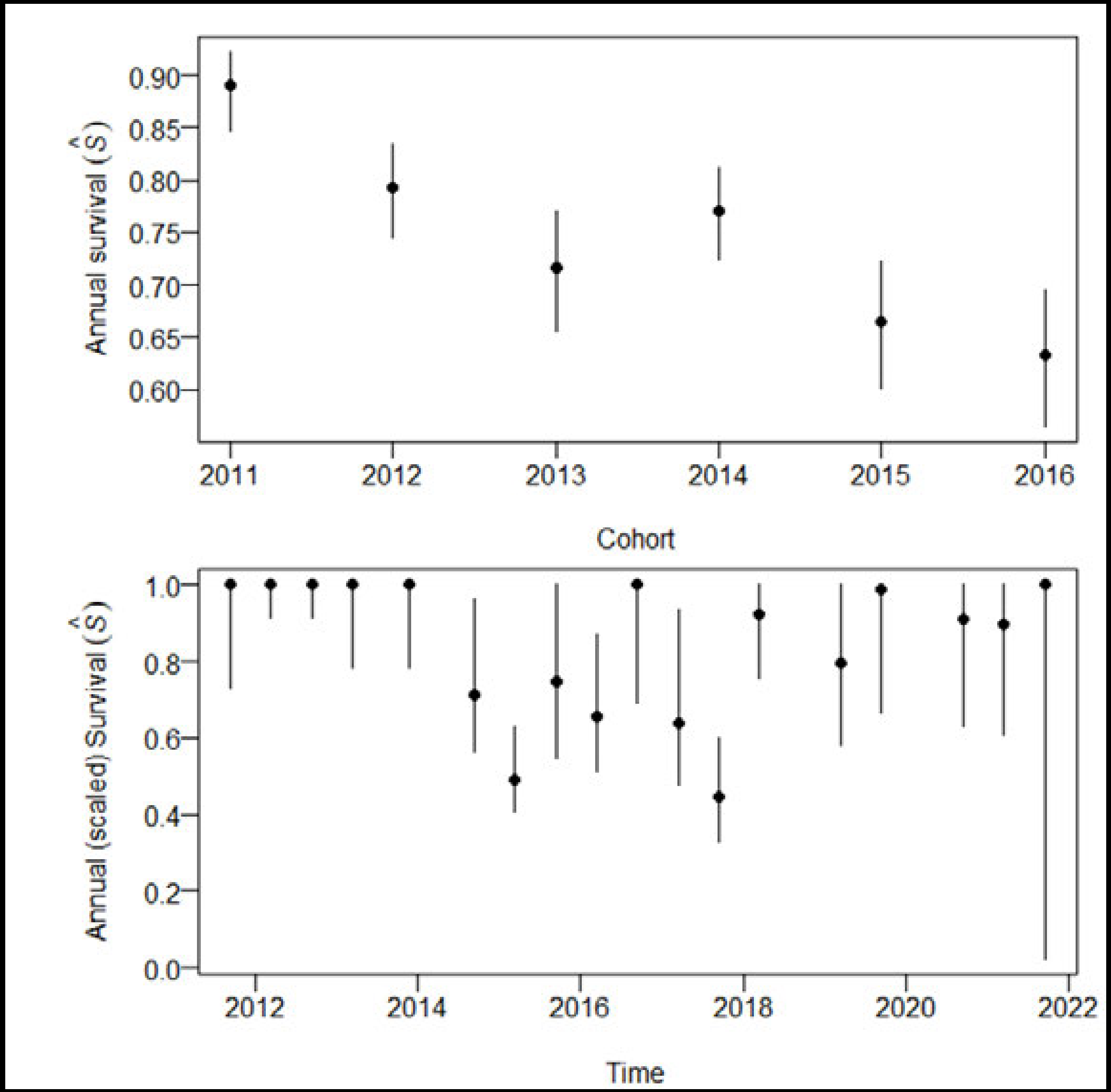
Recapture / Resights

A joint-live recapture/resight model "Barker's model"- estimate survival for HBC translocated to HAV (using data collected by NPS, AZGFD, GCMRC, and USFWS in HAV, the LCR, and the mainstem Colorado River; Healy et al. *in review*).



Recent & more widespread use of portable PIT tag antennas deployed by FWS, GCMRC, and NPS appears to significantly augment encounter histories and to improve estimates.

72 Havasu-translocated HBC had been detected in the mainstem Colorado River between 2011 and 2019 – while 34 were detected on the NPS-deployed portable antenna in the mouth of Havasu Creek from June- July 2021 alone.



Survival estimates in the time-varying model were scaled to be comparable to an annual rate.
The last estimate in 2021 is confounded with time-varying recapture/resight probability.

Havasu Creek Apparent Survival

Varied over time (bottom) and by cohort (top), ranging from 0.44 to near 1.0.

No environmental covariates were included in alternative survival models- previously survival was found to vary with HBC density and flood frequency (Healy et al. *in review*).

Survival is high for HBC translocated to Havasu and comparable to that in the Little Colorado River (Yackulic et al. 2021, 0.4 – 0.9).

Havasu Creek Abundance Estimation

The abundance estimate was 215 (95% CI 200 – 264)- considerably higher than the previous abundance estimate generated in spring of 2019 (116, 95% CI 109 – 153)

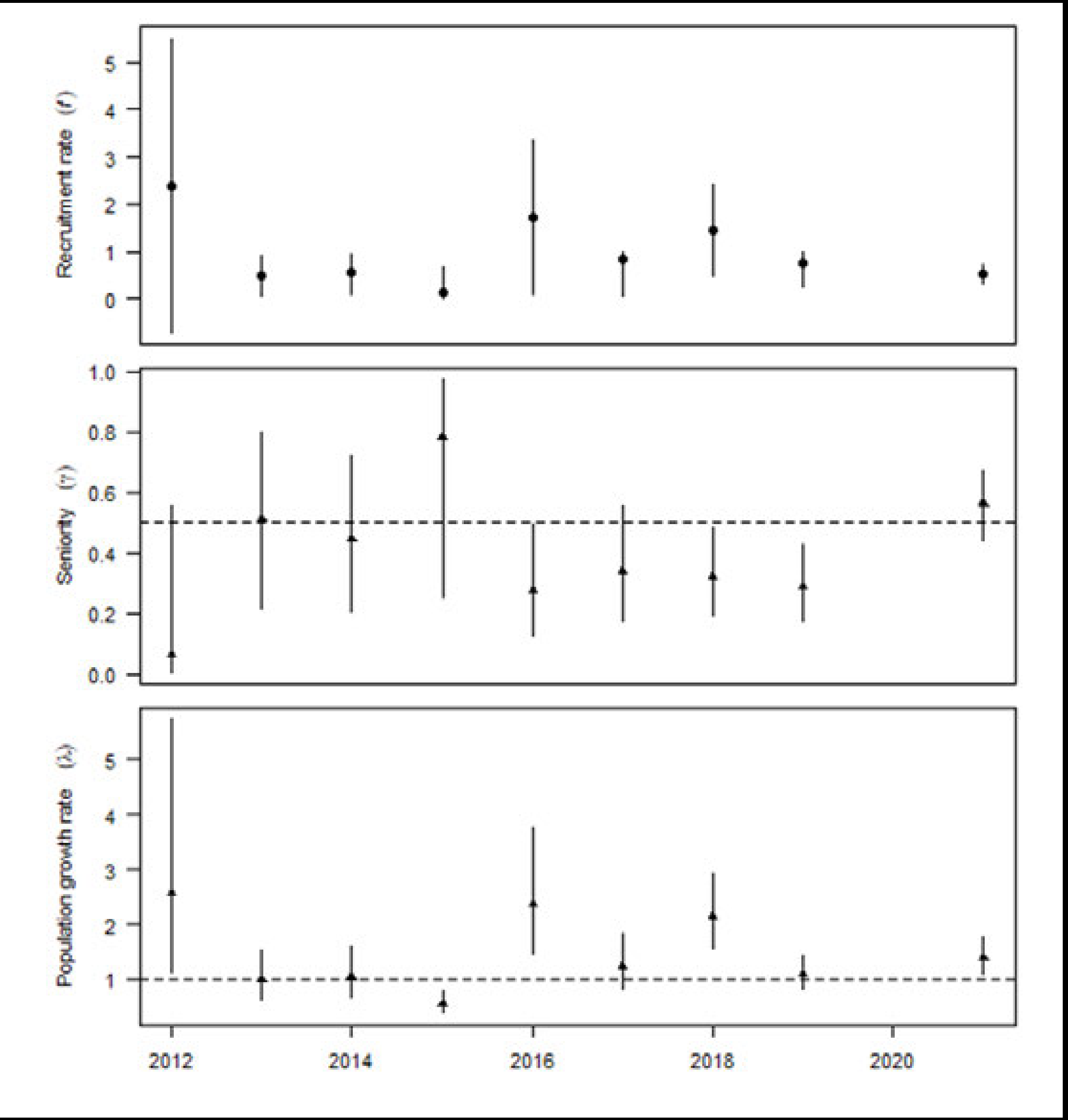
Genetic management plans recommend at least 200 HBC be maintained at each translocation site if reproduction occurs, with occasional augmentation with LCR fish as necessary to maintain genetic integrity (USFWS 2010, Van Haverbeke et al. 2016). The abundance now exceeds the population goal established in the NPS CFMP (2013).

The 2021 Havasu Creek population consists of 85% non-translocated fish, or wild fish.

		Estimate	SE	LCI	UCI
Translocation Cohort	2011	2	1	2	5
	2013	2	1	2	5
	2014	24	2	22	32
	2015	1	0	1	4
	2016	3	1	3	7
Non-translocated		182	10	170	211
Total		215		200	264

SE= standard error, LCI-= lower confidence interval, UCI= upper confidence interval

Havasu Creek Recruitment & Population Growth



A temporal symmetry model (Pradel 1996) was used with non-translocated HBC:

- recruitment estimate: 0.52 (95% C.I. = 0.32 - 0.71)
- seniority probability estimate: 0.66 (95% C.I. = 0.54 – 0.76)
- population growth estimate: 1.39 (95% C.I. = 1.09 – 1.77).

Population growth estimates have remained at 1 (i.e., 95% CIs overlap 1) or above 1 for the last several years in Havasu Creek, indicative of a stable or increasing population.

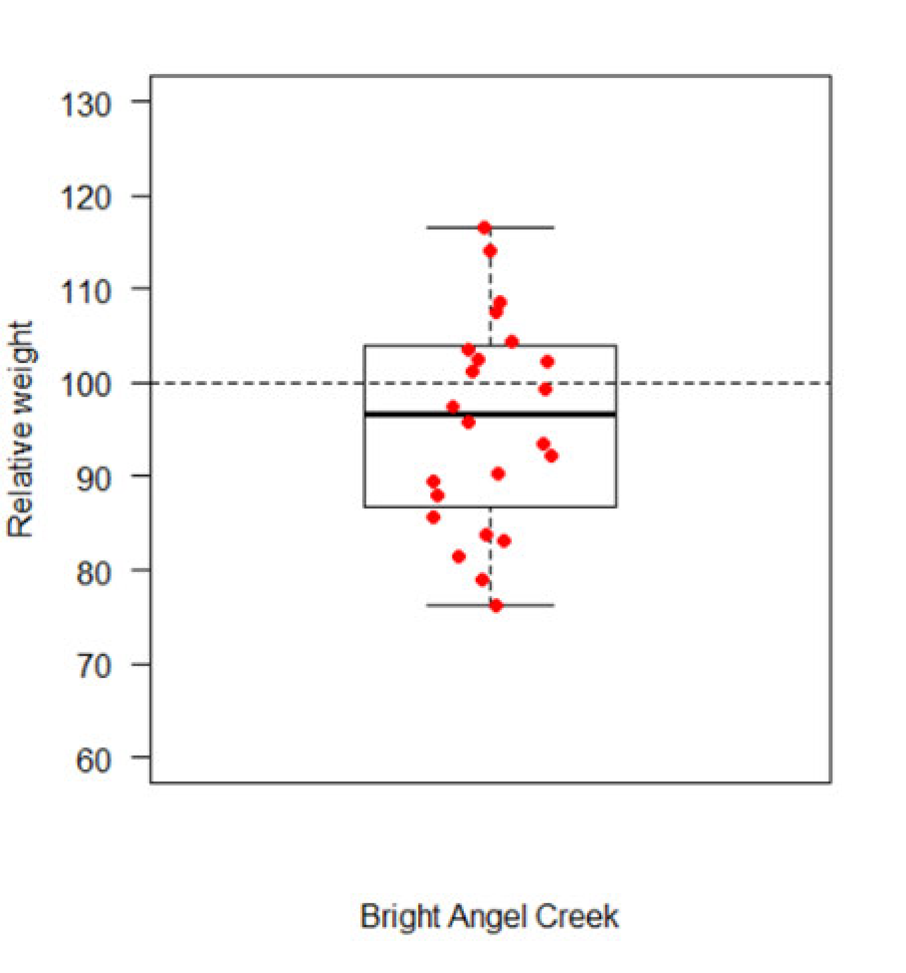
The higher 2021 seniority probability estimate (~0.50) relative to previous years indicates that this increase was more driven by high adult survival than recruitment.





Bright Angel Creek- preliminary

Bright Angel Creek Growth & Body Condition



- Translocation cohorts differed in size at release, and growth in HBC declines with age and size (Pine et al. 2017)- growth is difficult to compare. The average size of 2020 translocated HBC was similar to the 2009 & 2010 cohorts translocated to SHI.
- Annual total growth of 2020 cohort averaged 30.7 mm between June 2020 and June 2021. This rate is similar to annual growth rates for the 2009 & 2010 SHI cohorts (Spurgeon et al. 2015), but less than those published for the LCR (Stone et al. 2020).
- Median relative weights were also slightly lower than the published standard (i.e., <100) in June 2021- perhaps due to high trout densities (2020-2021) and a lack of flooding (summer 2020) (Healy et al. *in review*, Behn and Baxter 2019)

Bright Angel Creek PIT Antenna Detections

138 unique HBC detected since installation in May 2018 (translocated & non-translocated)

PIT-tag antenna array was destroyed during a flash flood on August 17, 2021

28 unique HBC (16 released in 2018, 11 from 2020, 1 RM 79.9) in FY 21

Most of the FY 2021 detections occurred between April and June- conditioning & spawning

After reinstallation, detection data will be incorporated into future mark-recapture models to estimate survival, emigration rates, and potentially abundance for translocated HBC

Summary

449 HBC captures during monitoring or trout suppression trips in FY 2021 including 355 in HAV, 46 in BAC, 48 in the combined tributary inflows (BAC, SHI, and HAV). PIT tag antennas also detected 34 unique translocated HBC in the HAV inflow and 28 unique HBC in BAC. PIT tag antenna data improve survival estimates.

In HAV, survival was relatively high and stable and comparable to that found for HBC in the LCR. The 2021 abundance estimate of 215 exceeds the population goal of 200. Reproduction and recruitment of the translocated population of HBC in HAV, first observed in 2016, continued.

SHI survival was comparable to the LCR until the Galahad Fire (2014). Mainstem abundance and survival modeling results before & after the fire suggest translocations to SHI can have important contributions to mainstem HBC aggregations.

Continue to gather data to assess BAC translocations and plan to install another PIT Tag antenna array. Preliminary data point to potential seasonal movements for conditioning and spawning.

During surveillance of potential invasive species hotspots, captured green sunfish, plains killifish, and fathead minnows along with native fish species.

Know someone who wants to volunteer?

Email me at emily_omana@nps.gov

Questions?